NEWPORT SYSTEM 6220

MULTI-FUNCTION COUNTER/TIMERS

OWNERS MANUAL

NEWPORT

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	218 FREQUENCY COUNTER	
	219 STOPWATCH OR ACCUMULATING STOPWATCH	
	220 PRESET TIMER (4 OPERATING MODES)	
	221 PRESCALING COUNTER	
	222 FACTORING COUNTER	
	223 DIGITAL RATIOMETER	
	224 DIFFERENTIAL SPEED MONITOR	

WARRANTY

All products of Newport Electronics, Inc. (Newport) are warranted against defective material and workmanship for a period of one (1) year from the date of delivery. Newport will repair or replace all defective equipment returned to it (transportation charges prepaid) during the warranty period without charge provided there is no evidence that the equipment has been mishandled or abused.

If, during the period of this warranty, the product appears to have a defect in materials or workmanship, please call your local Newport Representative or write directly to the Customer Service Department. Newport Electronics, Inc., 630 E. Young Street, Santa Ana, California 92705, and describe the problem.

All products returned to Newport must be insured by sender and must be carefully packaged and adequately protected such as to prevent breakage from shock and rough handling that might occur during shipment; all applicable shipping charges, insurance, duties and taxes must be prepaid by sender.

TABLE I

APPLICATION NOTES
SYSTEM 6220

APPLICATION NOTE NO	APPLICATION	MODULES REQUIRED	OPTIONS AND NOTES
215	UP/DOWN (BI-DIRECTIONAL) TOTALIZER	6222	
216	PRESET UP/DOWN COUNTER	6222 6223	CC4
217	PRESET UP/DOWN CONTROLLER	6222 6223	CC4
218	FREQUENCY COUNTER	6222-ST	TX1 or TX2
219	STOPWATCH OR ACCUMULATING STOPWATCH	6222-ST	TX1 or TX2
220	PRESET TIMER (4 OPERATING MODES)	6221 or 6222 6223	TX1 or TX2, EXTERNAL RELAY CC4
221	PRESCALING COUNTER	6221 6222-ST 6223	TX1 or TX2 CC4
222	FACTORING COUNTER	6221 6222-ST 6223	 TX1 or TX2 CC4
223	DIGITAL RATIOMETER	6221 6222-ST 6223	 SC3 CC4
224	DIFFERENTIAL SPEED MONITOR	6221 6222-ST 6223	SC3 TX 1 or TX 2 CC4

SECTION 1

GENERAL DESCRIPTION

1.0 GENERAL INFORMATION

The Newport Electronics 6220-Series Multifunction Counter/Timer line consists of DIN III Modules which can be connector-wired to form indicating and control functions of many kinds. The DIN III case requires only 96 by 26mm (3.78 x 1.02 in.) of panel space. An optional 115/230V RMS, 50/60 Hz, power supply is available for behind-the-panel mounting. Table 1 gives the available Application Notes with modules and options required for 10 standard applications. Contact your local Newport Electronics sales representative or the factory applications engineer for more information.

1.1 SCOPE AND USE OF THIS MANUAL

This Manual provides information to the user for the proper selection, handling, installation, function and operation of the basic system components. The Application Notes give system operation and wiring information for most applications.

1.2 COMPONENT DESCRIPTIONS

1.2.1 Models 6221, 6222 Totalizers

Each of these counters contain a 6-digit Very-Large-Scale-Integrated Totalizer chip. Its count and reset inputs can be driven from most logic systems.

The Model 6222 contains a 6-digit, orange 7-segment light-emitting diode (LED) display of 14mm (0.56") character height behind a contrasting filter, and a left-hand side reset pushbutton. The circuitry is mounted on the upper board in the DIN III case. Option cards can be mounted in the lower board position. The 6222 can be used alone in simple totalizing applications.

The Model 6221 is identical to the 6222 except without LED display and reset pushbutton. It is generally used with a 6222 and other 6220 system components to perform auxiliary functions such as generation of time bases dependent upon predetermined counts.

1.2.1.1 SC Option

The Signal Conditioning option card provides signal matching, clipping, buffering, time delays, logic elements and open-collector relay drives. Several versions are available for extending the capability of the basic Counters.

1.2.1.2 TX Option

This Counter/Timer option provides a crystal-controlled oscillator, a six decade time-base divider, control logic and relay-driver/output-buffer. It adds frequency counter, stopwatch, accumulating stopwatch and timer capability to the counters. Two oscillator accuracies are available.

1.2.3 Models 6223, 6224 Modules

The preset modules, in separate DIN III cases, add the capability for presetting the Models 6221 and 6222 Totalizers to a predetermined count or setting their Compare Registers; very useful in control applications. A typical application is a coil winder. The Totalizer is preset to the required number of turns and then counted down. The Compare Register is set to a small number. When the count equals the Compare Register, the Equal output operates a relay to slow down the winding speed. The Zero output is similarily used to stop the winding.

The Model 6223 has a single 6-decimal digit switch which can either preset the Totalizer or load the Compare Register. The Model 6224 has two 6-decimal digit switches to separate these functions. Loading is either manual, by means of a three-position (spring return to center position) front panel switch, or by external electrical control.

1.2.4 Model 6225

This module is an AC-to-DC Power Supply adequate for any of the standard applications. It comes in 115 and 230V RMS, 50/60Hz versions. It is intended for behind the panel mounting and comes in an enclosed case measuring 74 x 138 x 43mm (2.9 x 5.4 x 1.7"). Screw terminals are used for connections.

SECTION 2

INSTALLATION

2.0 INSTALLATION

Your 6220 modules have been thoroughly burned-in, tested, and inspected at the factory. You will obtain many years of reliable service with reasonable care in handling, connecting, and application of signals and power.

2.1 HANDLING

Except for the Model 6225 Power Supply, all of the 6220 series modules contain MOS integrated circuits to obtain complex performance at low cost in small volume. On-chip protection (resistor-diode networks) is provided for all inputs and outputs; however, care must be taken not to expose these circuits to the very high voltages which are sometimes obtained from static electricity.

Each 6220 module is shipped in a conductive foam bag and with a conductive-shorting bar on its protruding PC board edge connections. DO NOT REMOVE these shorting pieces until:

a) the mating PC board connectors are competely wired and thoroughly checked.

b) the person installing the connectors is grounded to the same panel or metal surface on which the case rests or is clamped.

Anti-static precautions (such as described in RCA Applications Note ICAN-6525) are not important in wet weather, high humidity, or where there is a flow of ionized air. Nevertheless, they are recommended as a matter of routine when dealing with MOS devices.

2.2 POWER REQUIREMENTS

2.2.1 Specifications

Voltage . . . . . .+10 to +16Vdc continuous
+20V absolute maximum transient (less than 5% duty cycle)

Current . . . . . .300mA for most applications

Ripple. . . . . .1V peak-to-peak max.

2.2.2 Typical Loading

Typical power requirements of the Model 6220 components at +12 volt power supply input are as follows:

6221 Totalizer (w/o display).....25mA

6222 **Totalizer**.....160mA

Opt. SC (Signal Conditioner).....20mA

Opt TX (Counter/Timer).....6mA

6223 Preset (single).....<1mA

6224 Preset (dual).....<1mA

External relay requirements are additional.

The Model 6225 Power Supply will supply a minimum of 300mA at +10Vdc at low input line voltage. This will operate any of the standard applications including external sensitive relays. Other power supplies should be used when more current is required.

2.2.3 Over Voltage

The wide voltage range of the 6220 system components allow them to be operated from unregulated power supplies, batteries, etc. If the supply chosen may swing above 20 volts, a clipping circuit is required. Figure 2.1 shows a simple circuit adequate for a source with up to 10A capability.

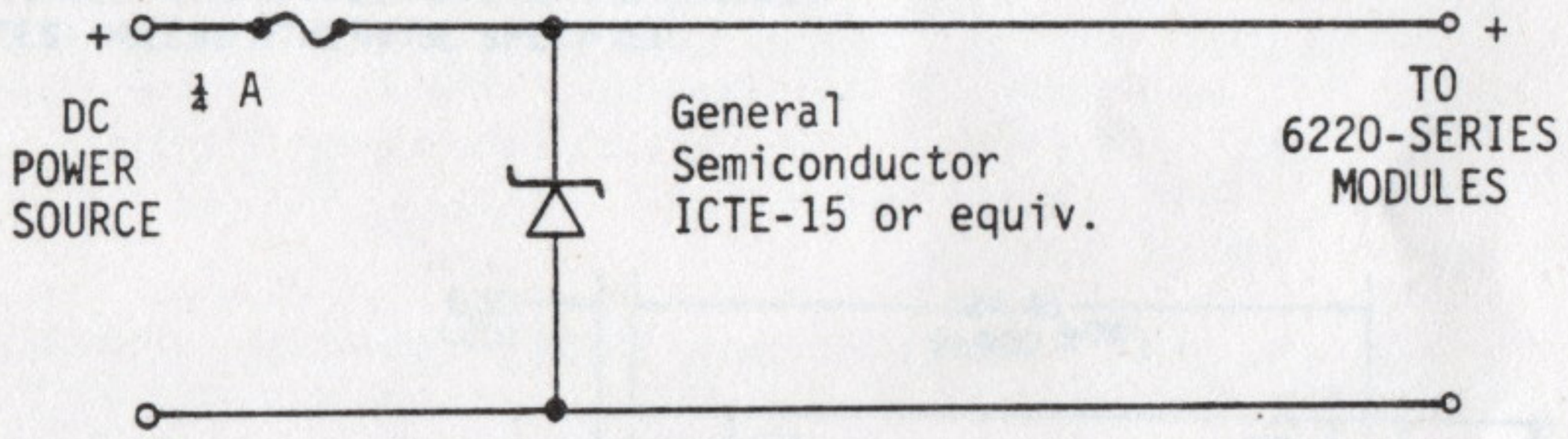


FIGURE 2.1

2.3 CASE OUTLINES AND MOUNTING DIMENSIONS

2.3.1 DIN III Case

The DIN III case dimensions are shown in Figure 2.2. The standard panel cutout is as follows:

Width . . . . . .92 $^{+1.3}_{-0.0}$ mm (3.622 $^{+.051}_{-.000}$ in.)

Height. . . . . .22.2 $^{+1.3}_{-0.0}$ mm (.875 $^{+0.51}_{-.000}$ in.)

When DIN III cases are mounted closer than one inch apart, the spring clamp becomes inconvenient to use. In such cases, specify the U-Mounting Clamp, Option UC.

2.3.2 Model 6225 Power Supply

Case dimensions for the 6225 Power Supply are given in Figure 2.3. The power supply mounts on any flat surface (preferably metal). Connections are to a barrier strip which uses 4 - 40 screws. Preferably, the connections should be with spade lugs attached to the wires. Because high-voltage connections are made, the plastic barrier strip cover should be installed after the connections are made.

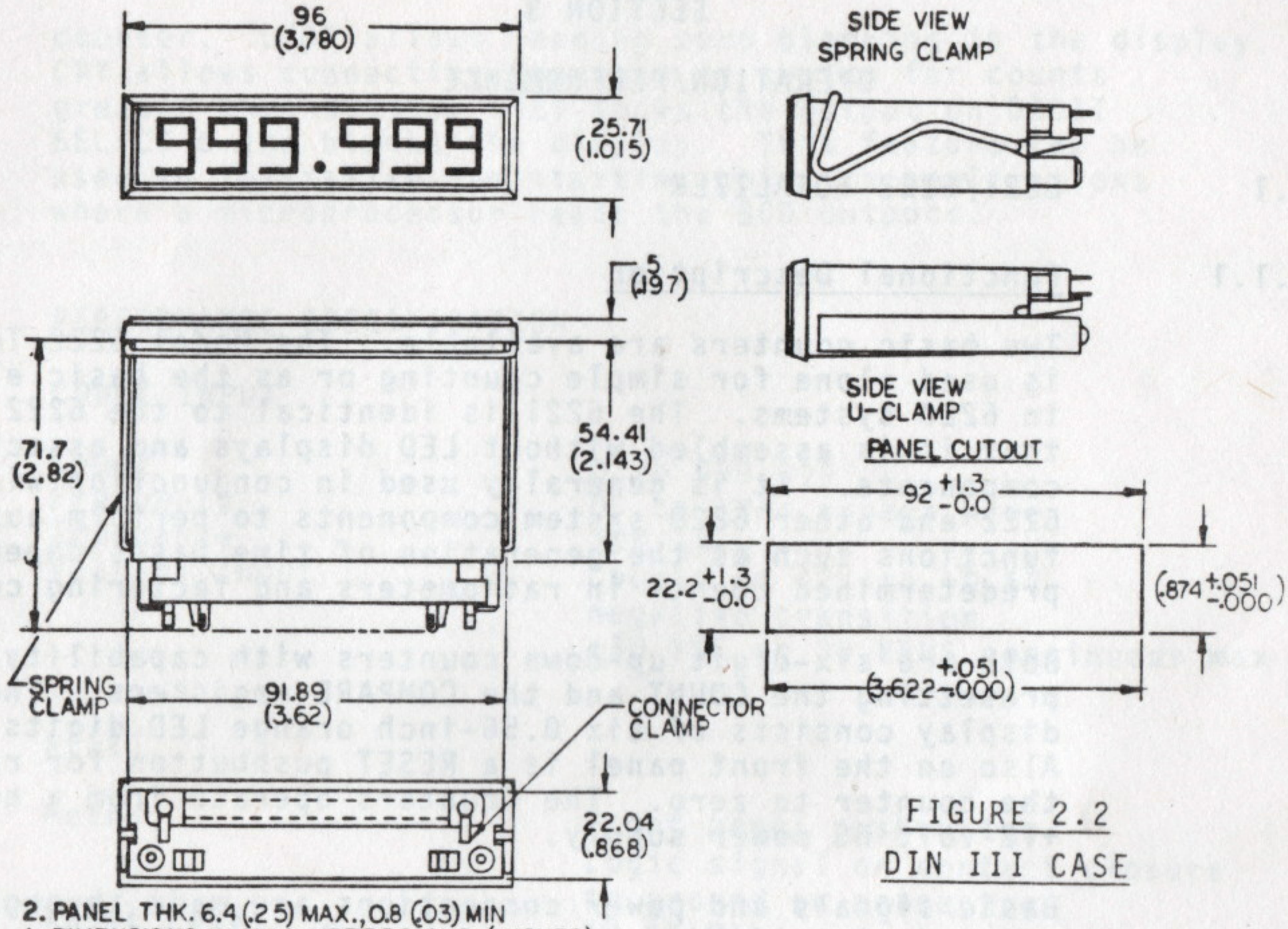


FIGURE 2.2

DIN III CASE

2. PANEL THK. 6.4 (.25) MAX., 0.8 (.03) MIN
1. DIMENSIONS IN MILLIMETERS AND (INCHES).
NOTES: UNLESS OTHERWISE SPECIFIED.

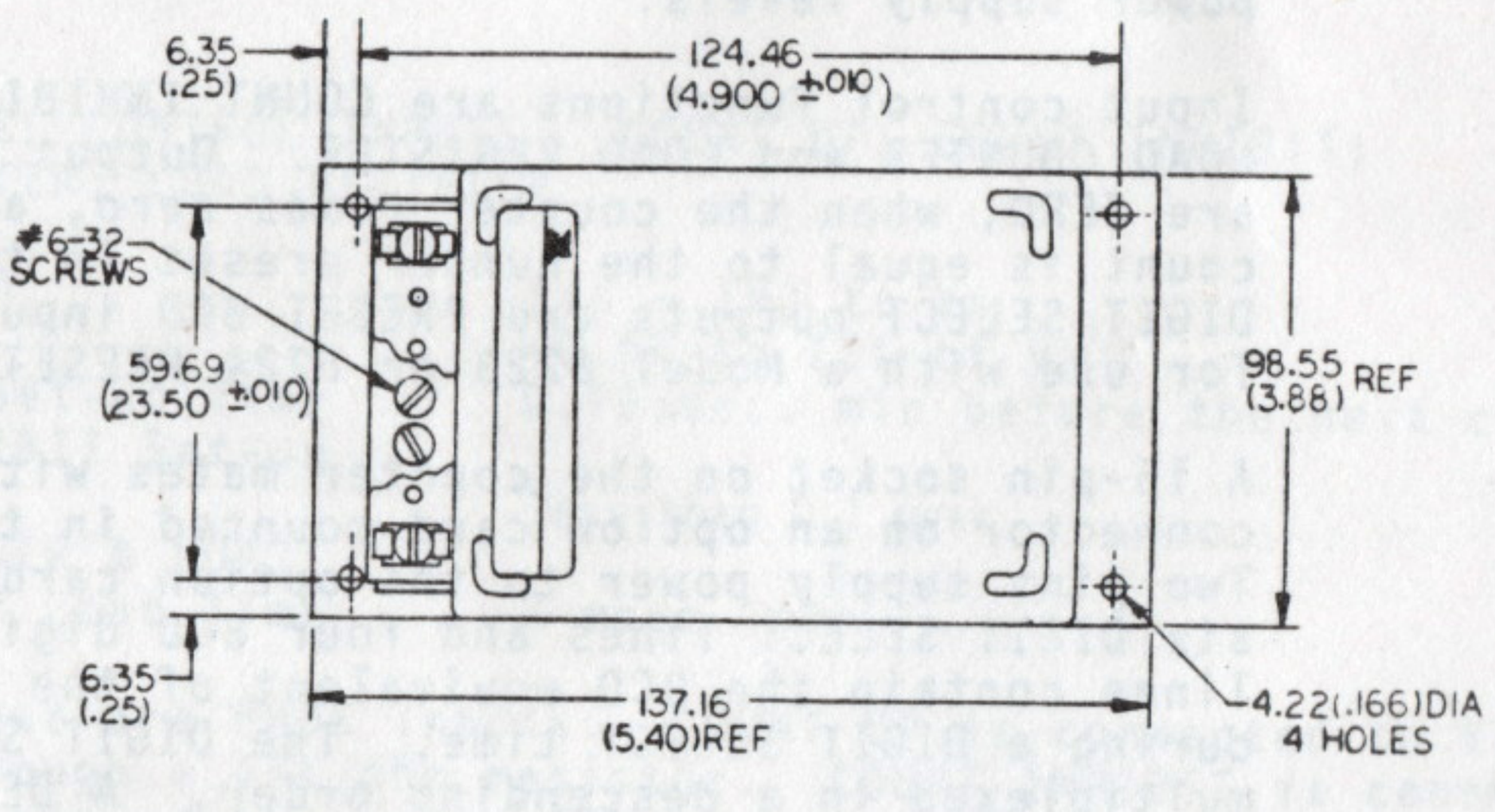
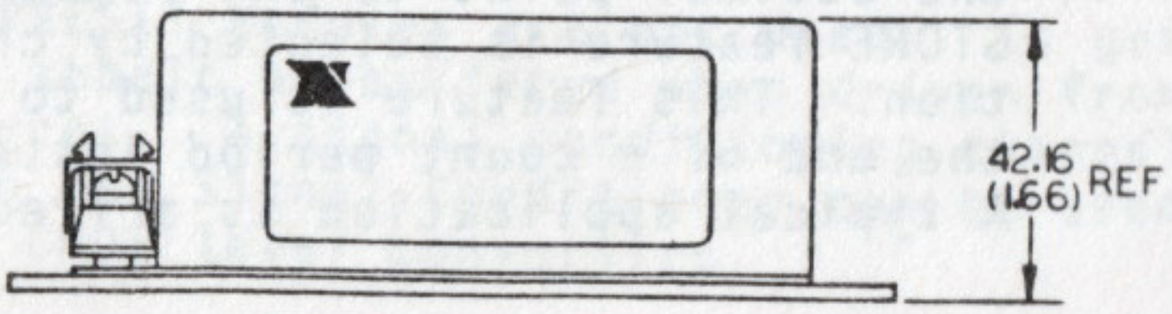


FIGURE 2.3

MODEL 6225 POWER SUPPLY



NOTES: DIMENSIONS IN MILLIMETERS ±0.51 MM
AND IN (INCHES) ±.02 IN.

SECTION 3

OPERATION/PERFORMANCE

3.1 6221/6222 TOTALIZER

3.1.1 Functional Description

Two basic counters are available. The Model 6222 Totalizer is used alone for simple counting or as the basic element in 6220 systems. The 6221 is identical to the 6222 except that it is assembled without LED displays and associated components. It is generally used in conjunction with a 6222 and other 6220 system components to perform auxillary functions such as the generation of time bases dependent upon predetermined counts in ratiometers and factoring counters.

Both are six-digit up-down counters with capability for presetting the COUNT and the COMPARE registers. The display consists of six 0.56-inch orange LED digits. Also on the front panel is a RESET pushbutton for resetting the counter to zero. The Counters operate from a nominal +12 volt DC power supply.

Basic signals and power connections are made through a printed-circuit edge connector on the rear of the module. The Counter counts negative-going transitions or standard DTL, TTL and CMOS logic levels. Reset of the counter to zero is accomplished by a low logic signal or contact closure to ground. All other inputs and outputs are at the +12 volt DC power supply levels.

Input control functions are COUNT INHIBIT, COUNT UP (DOWN), LOAD COUNTER and LOAD REGISTER. Output control functions are ZERO, when the counter reads zero, and EQUAL, when the count is equal to the number preset in the COMPARE register. DIGIT SELECT outputs and PRESET BCD inputs are available for use with a Model 6223 or 6224 PRESET Module.

A 15-pin socket on the counter mates with an internal connector on an option card mounted in the counter module. Two pins supply power to the option card. Outputs are the six DIGIT SELECT lines and four BCD digit lines. The BCD lines contain the BCD equivalent of the displayed digit during a DIGIT SELECT time. The DIGIT SELECT lines are multiplexed in a descending order. A DEC POINT input is provided, and a decimal point driver is required on the option card. Turning this drive on during a DIGIT SELECT time lights the decimal point to the right of the selected digit. The STORE feature is selected by changing a solder-switch connection. This feature is used to change the display only at the end of a count period instead of continuous updating. A typical application is a frequency

counter. LZBF allows leading zero blanking in the display. CRY allows connecting Counters in series for counts greater than 999999. SET locks the output on DIGIT SELECT 6 and blanks the display. This feature can be used to initialize the starting point in applications where a microprocessor reads the BCD outputs.

3.1.2 PERFORMANCE SPECIFICATION

3.1.2.1 COUNT INPUT

Count	0 to 999,999
Frequency	DC to 1MHz square wave
Impedance	10K ohms
Voltage Input	Counts on +2V to +0.5V negative transition ±30 VDC or 30 VRMS continuous max

3.1.2.2 RESET

Means	Front panel pushbutton Logic signal or contact closure to ground on connector
Reset Level	+0.5V max
Not-Reset Level	+2.0V min
Reset Pulse Duration	2µsec. min
Impedance	82K ohms to Vs, 10K ohms to ground
Voltage Input	±30 VDC or 30 VRMS continuous max

3.1.2.3 LOGIC-LEVEL CONTROL INPUTS: COUNT UP; COUNT INHIBIT; LOAD COUNTER; LOAD REGISTER

Input High	(Vs - 1V) to Vs
Input Low	-0.5V to 20% of Vs
COUNT UP Set-up Time	0.75µsec. min before the next count
COUNT INHIBIT Set-up Time	less than 0.1 µsec
LOAD COUNTER & LOAD REGISTER Load Time	2 msec. min

Note: These are PMOS inputs. COUNT UP is connected to Vs through a 47K ohm resistor. COUNT INHIBIT is connected to ground through a 47K ohm resistor. The Counter will therefore count up with no external connections. LOAD COUNTER and LOAD REGISTER should be connected to ground when PRESET Modules are not used. In general, these inputs should be buffered when driven from external sources. A signal conditioning channel or the comparator on the Signal Conditioner can be used for DTL, TTL, or CMOS level conversion.

3.1.2.4 INPUTS: PRESET BCD 1, 2, 4 & 8

These inputs are used to preset the COUNT and COMPARE registers. They are active during LOAD COUNTER and LOAD REGISTER. The PRESET Module provides the required delay on these inputs.

3.1.2.5 OUTPUTS: DIGIT SELECT 1 through DIGIT SELECT 6

These outputs are used internally for driving the display and externally with the PRESET Module and decimal point driver on the TX option. CMOS buffers are required for other external usage.

The DIGIT SELECT rate is between 6KHz and 15KHz when the Counter is not counting or changing control functions. Therefore, the maximum time for scanning all digits is one millisecond.

3.1.2.6 OUTPUTS: ZERO; EQUAL

These two signals are true when the counter readings are equal to zero and when it equals the number in the COMPARE register respectively.

Output High (true)	80 to 100% of Vs at 1.5 mA
Output Low (false)	0 to 20% of Vs at 30μA
Access Time - ZERO	3μsec. max
Access Time - EQUAL	2μsec. max
Frequency Response	DC to 200KHz (for full pulse output)

3.1.2.7 INTERCONNECTIONS

A connector provides the following signals to the Signal Conditioner, Counter/Timer or other option cards within the case:

Power	Vs and ground
DIGIT SELECTS 1 thru 6	Digit-time outputs
BCD 1, BCD 2, BCD 4 & BCD 8	BCD Digit Data outputs
ZERO; $\overline{\text{EQUAL}}$	Outputs
STORE/$\overline{\text{SET}}$	Control Input
CRY/LZBF	Signal Output/Control Input
DEC POINT	Decimal Point Drive Input

3.1.2.7.1 BCD Digit Data Output

BCD digit data for each displayed digit is available during that DIGIT SELECT time. The output levels are the same as for ZERO and EQUAL, par. 3.1.2.6.

3.1.2.7.2 STORE/$\overline{\text{SET}}$

One of these functions may be accessed by solder switch connections on the Counter.

3.1.2.7.2.1 The STORE input is connected to an input pin by solder-switch connections. STORE retains the last (not) STORE display and BCD Digit Data.

Input High (STORE)	(Vs - 1V) to Vs
Input Low (not STORE)	-0.5V to 20% of Vs
Counter Access Time ((not) STORE)	2µsec. min

3.1.2.7.2.2 $\overline{\text{SET}}$

$\overline{\text{SET}}$ locks the output on DIGIT SELECT 6 and blanks the display.

Input Levels	Same as STORE, para. 3.1.2.7.2
Input Impedance	47K ohms to Vs

3.1.2.7.3 CRY/LZBF

One of these functions may be accessed by solder-switch connections on the Counter.

3.1.2.7.3.1 CRY

The CARRY output goes high with the negative transition of the COUNT INPUT at the count of 000000 when counting up or at 999999 when counting down and goes low with the positive transition of the same input. The output levels are the same as for ZERO and EQUAL, par. 3.1.2.6. CRY may not respond above 400KHz COUNT INPUT.

3.1.2.7.3.2 LZB (Same as LZBF)

When the LZB function is brought out, it can be externally grounded blanking all leading zeros in the display and BCD output.

3.1.2.8 POWER

Voltage	+10 V to + 16 V continuous +20 V max. for 1 ms transient
Current	175 mA maximum
Ripple	1 V peak to peak maximum

3.1.3 SOLDER SWITCH CONFIGURATIONS

3.1.3.1 LEADING ZEROS - LZB

BLANK LEADING ZEROS:

Open solder-switch 'A' (interrupts display of leading zeros)
Open solder-switch 'H' (disconnects carry-out function from Pin 1 of J2)
Close solder-switch 'F'(brings out LZB to Pin 1 of J2)

DISPLAY LEADING ZEROS:

Open solder-switch 'F' (disconnects LZB from Pin 1 of J2)
Close solder-switch 'A'(allows display of leading zeros)

3.1.3.2 CARRY OUT - CRY

Used for cascading (chaining) counter modules in series. This signal goes high on the leading edge of the '000000' count in count-up mode or '999999' count in count down mode. Open solder-switch 'F' (disconnects LZB from Pin 1 of J2). Close solder-switch 'H' (connects CARRY OUT to Pin 1 of J2).

3.1.3.3 SET DIGIT SCAN - SET

Used for synchronizing the internal digit counter for demuxing BCD output to outside world (control applications). When brought low (GND) it inhibits the digit scan (while blanking the display) and sets the BCD outputs equal to the value of the MSD.

When brought high (+V supply) normal digit scan resumes and the BCD outputs begin muxing from the MSD towards the LSD. Open solder-switch 'B' (inhibits normal digit scan). Open solder-switch 'D' (disconnects STORE function from Pin 6 of J2). Close solder-switch 'C' (connects SET to Pin 6 of J2).

3.1.3.4 STORE COUNTER TO DISPLAY - STORE

A low level (GND) applied allows display to follow counter contents as counter updates.

A high level (+V supply) instantaneously latches the counter value in the display register while allowing counter update. Open solder-switch 'C' (disconnects SET from Pin 6 of J2). Open solder-switch 'E' (allows the display to be latched). Close solder-switch 'D' (connects STORE to Pin 6 of J2).

NOTE: Completed unit deviates from Revision 'A' Schematic as follows:

1. Solder switches 'D' and 'F' are normally open (removes STORE input from Pin 6)
2. Solder switch 'H' is normally closed (brings CARRY output to Pin 1).
3. Pin 6 of J2 is now STORE/$\overline{\text{SET}}$.
4. Pin 1 of J2 is now CRY/$\overline{\text{LZB}}$.

.1.4 PIN ASSIGNMENTS

COUNTER - 6221, & 6222:

P2-1	COUNT UP	P2-A	PRESET BCD 1
P2-2	ZERO	P2-B	PRESET BCD 2
P2-3	COUNT INHIBIT	P2-C	PRESET BCD 4
P2-4	LOAD COUNTER	P2-D	PRESET BCD 8
P2-5	LOAD REGISTER	P2-E	DIGIT SELECT 6
P2-6	EQUAL	P2-F	DIGIT SELECT 5
P2-7	COUNT INPUT	P2-H	DIGIT SELECT 4
P2-8	(NOT) RESET	P2-J	DIGIT SELECT 3
P2-9	+12V DC	P2-K	DIGIT SELECT 2
P2-10	GROUND	P2-L	DIGIT SELECT 1

INTERCONNECTIONS TO OPTION CARD:

J2-1	CRY/LZBF
-2	BCD 1 OUT
-3	BCD 2 OUT
-4	BCD 4 OUT
-5	BCD 8 OUT
-6	STORE/$\overline{\text{SET}}$
-7	Vs
-8	GND
-9	DIGIT SELECT 1
-10	DIGIT SELECT 2
-11	DIGIT SELECT 4
-12	DIGIT SELECT 5
-13	DIGIT SELECT 6
-14	DECIMAL POINT
-15	DIGIT SELECT 3

MAIN BOARD

DISPLAY BOARD

DEC POINT 14
BCD 1 OUT 2
BCD 2 OUT 3
BCD 4 OUT 4
BCD 8 OUT 5
VS 7
(NOT) STORE 6
CRY/(NOT) LZB 1
DIGIT SELECT 1 9
DIGIT SELECT 2 10
DIGIT SELECT 3 15
DIGIT SELECT 4 11
DIGIT SELECT 5 12
DIGIT SELECT 6 13
GND 8

J2

BCD OUT

U2A

SET STORE

SEGMENTS

DIGIT SELECTS

LZB 1 2 3 4 5 6 SCAN

VS

A B C D E F

VR1 IN753A

R12 100K

C2

Q1

U4

R11 47K

CR3 1N4448

C3 100 10V

C1 10 25V

L1

+12V

C4 220pf

U1

R3 75
R7 75
R8 75
R4 75
R2 75
R5 75
R6 75

DS1
DS2
DS3
DS4
DS5
DS6

CATH

P2

DIGIT SELECT 1 L
DIGIT SELECT 2 K
DIGIT SELECT 3 J
DIGIT SELECT 4 H
DIGIT SELECT 5 F
DIGIT SELECT 6 E
GROUND 10

PRESET BCD 1 IN A
PRESET BCD 2 IN B
PRESET BCD 4 IN C
PRESET BCD 8 IN D

LOAD REGISTER 5
LOAD COUNTER 4
EQUAL 6
ZERO 2

+12 VDC 9

COUNT INPUT 7

COUNT INHIBIT 3
COUNT UP 1
(NOT) RESET 8

U2B

LDR LDC CTR REG CRY EQL ZERO CK INH UP SER

CR4 1N4004
R14 4.7K
R10 10K
Q2 2N5769
CR2 1N4448
R1 47K

R15 4.7K
R16 82K
R17 82K
Q1 2N5769
CR1 1N4448
R13 47K

U3

S1 RESET

DS 1 THRU 6 TYP

a b c d e f g

R10, C4, CR4, VR1, U4, DS6, S1, L1, Q2, P2, J2

LAST REFERENCE DESIGNATION USED

6226-2	YES	--	--	CTR/TMR
6226-1	YES	"E"	--	CTR/TMR
6225-3	YES	"E"	--	SIG COND
6226-2	YES	--	--	SIG COND
6225-1	YES	--	--	SIG COND
6229	YES	--	--	--
6223	--	--	--	CTR/TMR
6222	--	--	--	SIG COND
6221	--	--	--	--
MODEL NO.	DISPLAY	DIGIT BLANKING	LEADING ZERO BLANKING	OPT. BD

U2	9318	SC395	22	1	—	
U4	9618	3039	4	7	-	
U3	9760	75492	-	11	4	
U1	9818	8062	5	15	-	
REF DES	PART NO.	TYPE	SUB	VS	GND	

UNLESS OTHERWISE SPECIFIED DIMENSIONAL TOLERANCES ARE

X	.3	—
.X	.1	—
.XX	.03	.01
ANG	—	BSC

DR		2/1/71
CHK		
APP'D		2/16/71
MFG APP'D		2/16/71

NEWPORT LABORATORIES INC.
630 E. YOUNG STREET
SANTA ANA, CALIFORNIA 92705

TITLE
SCHEMATIC DIAGRAM, TOTALIZER

SIZE	CODE IDENT NO	NO
D	32873	07072

SCALE — SHEET 1 OF 1

A	RELEASE	1-5-70	RSF
CHG	LTR	DATE	BY

1. SEE PARTS LIST NO 07070-01,-02.
2. CAPACITORS VALUED IN MICROFARADS
3. RESISTORS VALUED IN OHMS ±5%, ¼ W.

NOTE: UNLESS OTHERWISE SPECIFIED

3.1.4 PIN ASSIGNMENTS

COUNTER - 6221, 6222

P2-1	COUNT UP	P2-A	PRESET BCD 1
-2	ZERO	-B	PRESET BCD 2
-3	COUNT INHIBIT	-C	PRESET BCD 4
-4	LOAD COUNTER	-D	PRESET BCD 8
-5	LOAD REGISTER	-E	DIGIT SELECT 6
-6	EQUAL	-F	DIGIT SELECT 5
-7	COUNT INPUT	-H	DIGIT SELECT 4
-8	(NOT) RESET	-J	DIGIT SELECT 3
-9	+12V DC	-K	DIGIT SELECT 2
-10	GROUND	-L	DIGIT SELECT 1

INTERCONNECTIONS TO OPTION CARD

J2-1	CRY/LZBF
-2	BCD 1 OUT
-3	BCD 2 OUT
-4	BCD 4 OUT
-5	BCD 8 OUT
-6	STORE/SET
-7	Vs
-8	GND
-9	DIGIT SELECT 1
-10	DIGIT SELECT 2
-11	DIGIT SELECT 4
-12	DIGIT SELECT 5
-13	DIGIT SELECT 6
-14	DECIMAL POINT
-15	DIGIT SELECT 3

USE OF THIS PROPRIETARY INFORMATION IS RESTRICTED TO MAINTENANCE OF OUR PRODUCTS OR FABRICATION TO OUR ORDER.

07072

MAIN BOARD | DISPLAY BOARD

DEC POINT 14
BCD 1 OUT 5
BCD 2 OUT 4
BCD 4 OUT 3
BCD 8 OUT 2
J2

U2A
BCD OUT 1 2 4 8
SET
STORE
SEGMENTS g f e d c b a
DIGIT SELECTS
LZB 1 2 3 4 5 6 SCAN
24 25 26 27 28 29 21

VS
R17 47K
R18 47K
R19 47K
A [4]
B
D [4]
STORE 6
CRY/(NOT) SET 1
DIGIT SELECT 1 9
DIGIT SELECT 2 10
DIGIT SELECT 3 15
DIGIT SELECT 4 11
DIGIT SELECT 5 12
DIGIT SELECT 6 13
GND 8
J2

VR1 IN753A
R12 100K
C2
Q1
R11 47K
CR3 IN4448
C3 100 10V
C1 10 25V
L1
+5V
C4 220pf
U4

U1
R3 75
R7 75
R8 75
R4 75
R2 75
R5 75
R6 75

DS1
DS2
DS3
DS4
DS5
DS6
CATH
DS 1 THRU 6 TYP

P1
DIGIT SELECT 1 L
DIGIT SELECT 2 K
DIGIT SELECT 3 J
DIGIT SELECT 4 H
DIGIT SELECT 5 F
DIGIT SELECT 6 E
GROUND 10
[4] C

PRESET BCD 1 IN A
PRESET BCD 2 IN B
PRESET BCD 4 IN C
PRESET BCD 8 IN D

U2B
LDR 8 4 2 1 8 4 2 1 CRY RES
LDC CTR REG
EQL
ZERO
CLK INH UP
16 17 18 19 32 33 34 35 38
30 31 23 39 20 36 37 40

LOAD REGISTER 5
LOAD COUNTER 4
EQUAL 6
ZERO 2

R15 4.7K
R16 82K
R9 10K
Q1 2N5769
CR1 IN4448

+12 VDC 9
CR4 IN4004
R14 4.7K
COUNT INPUT 7
R10 10K
Q2 2N5769
CR2 IN4448
R1 47K
R13 47K

U3

S1
RESET

COUNT INHIBIT 3
COUNT UP 1
(NOT) RESET 8

[4] FOR SOLDER SWITCH CONNECTIONS SEE CHART
3. SEE PARTS LIST NO. 07070-01,-02.
2. CAPACITORS VALUED IN MICROFARADS.
1. RESISTORS VALUED IN OHMS ±5%, 1/4 W.
NOTE: UNLESS OTHERWISE SPECIFIED

STORE+LZB OPTS	YES	A	B,C,D
LZB OPT. ONLY	YES	A,B	C,D
STORE OPT. ONLY	EITHER	A	B,C,D
6222	YES	A,B,D	C
6221	NO	A,B,D	C
MODEL	DISPLAY	OPEN SOLDER	CLOSED SWITCHES

REF DESIG	NEI P/N	TYPE	GND	VS	+5V
U2	49816	50395	22	1	—
U4	49815	3094	4	7	—
U3	49760	75492	—	11	4
U1	49814	3082	5	15	—

R19, C4, CR4, VR1, U4, DS6, S1, L1, Q2, P1, J2
LAST REFERENCE DESIGNATION USED

TABULATION

CHG	E.O. NO.	DATES	BY	CHK
C	2668	12-18-80	AGR	
B	2473	7-24-80	VB	
A	RELEASE	1-5-80	RSF	

UNLESS OTHERWISE SPECIFIED DIMENSION TOLERANCES ARE:
MM IN
X 1.3 —
.X .5 .1
.XX .25 .02
.XXX — .010
ANGLES ± 0° 30'
DO NOT SCALE PRINT
MATERIAL
FINISH

BY	DATE
DR FOLEY	1/5/80
CHK	
APPD	2/13/80
APPD	2/13/80

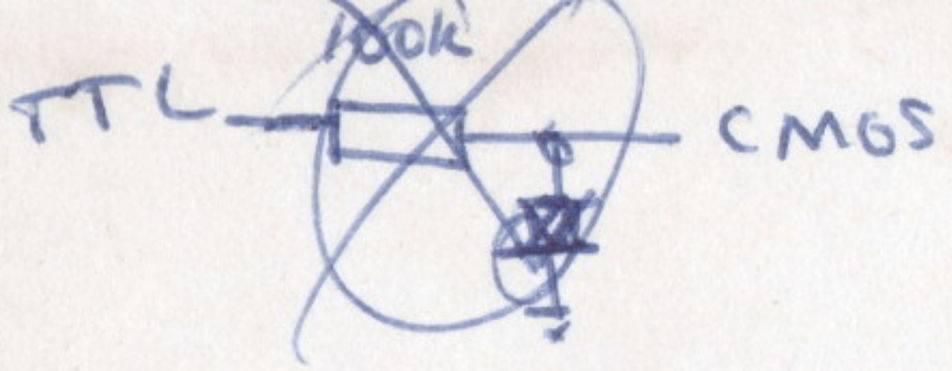
NEWPORT LABORATORIES, INC.
630 E. YOUNG STREET
SANTA ANA, CALIFORNIA 92705

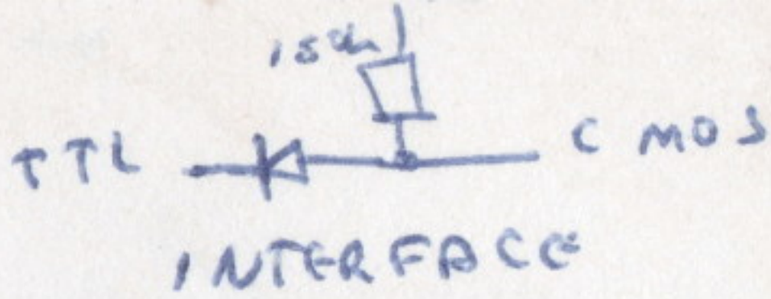
TITLE
SCHEMATIC DIAGRAM, COUNTER

SIZE	CODE IDENT NO.	NO.
D	32873	07072

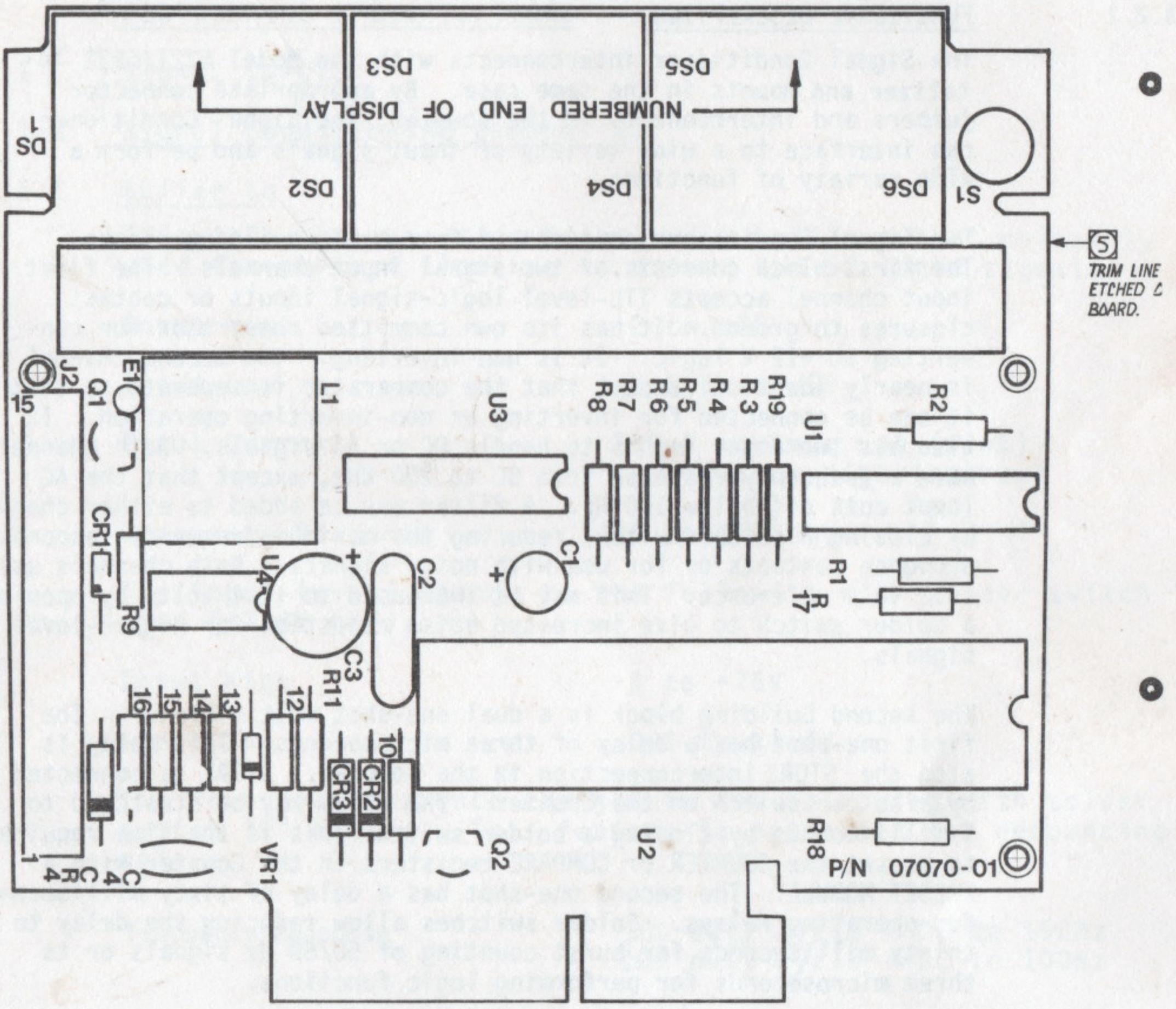
SCALE | MODEL SEE | SHEET 1 OF 1

07072

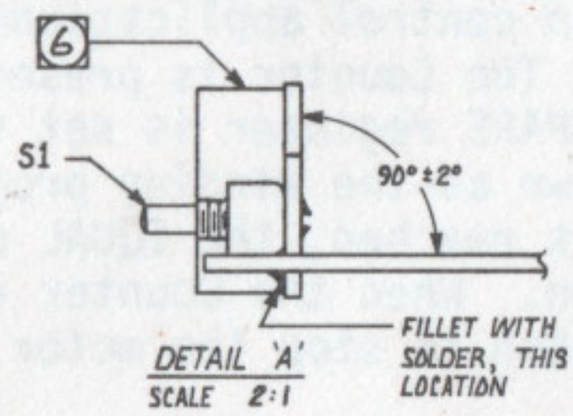




REDUCE TO 3.275 ±.005



PW.B. 07073-01 S.S.M. 07070-00



CHG	E.O. NO.	DATES	BY	CHK
D	2551	8/4/80		
C	2473	7/10/80	RSF	
B	RELEASE	3/13/80	RSF	

BY	DATE
DR T. JOHNSON	7/20/78
CHK	6-12-79
APPD L. Schuyler	6-12-79
APPD	6-12-79
FINISH	

NEWPORT LABORATORIES, INC.
630 E. YOUNG STREET
SANTA ANA, CALIFORNIA 92705

TITLE ASSEMBLY, PRINTED CIRCUIT BOARD - TOTALIZER

SIZE	CODE IDENT NO.	NO.
C	32873	07070-00

SCALE 4:1 | MODEL 6220 | SHEET 1 OF 1

6. DENOTES NUMBERED END OF DS1 THRU DS6.
5. DETACH DISPLAY BD. WHERE SHOWN AND ASSEMBLE PER DETAIL 'A'.
4. RUBBER STAMP APPROPRIATE SERIAL NO. APPROXIMATELY WHERE SHOWN.
3. REF. SCHEMATIC NO. 07072.
2. REF. PARTS LIST NO. 07070-01.
1. ASSEMBLE PER WORKMANSHIP MANUAL 02281-01.

NOTES: UNLESS OTHERWISE SPECIFIED.

3.2 SC (SIGNAL CONDITIONER) OPTIONS

3.2.1 FUNCTIONAL DESCRIPTION

The Signal Conditioner interconnects with the Model 6221/6222 Totalizer and mounts in the same case. By appropriate connector jumpers and interconnects to the Counter, the Signal Conditioner can interface to a wide variety of input signals and perform a wide variety of functions.

The Signal Conditioner consists of four basic building blocks. The first block consists of two signal input channels. The first input channel accepts TTL-level logic-signal inputs or contact closures to ground. It has its own committed comparator for converting to +12 V logic. It is non-inverting. The second channel is nearly identical except that the comparator is separate so that it can be connected for inverting or non-inverting operation. It also has two other inputs to handle DC or AC signals. Both channels have a frequency response from DC to 200 KHz, except that the AC Input cuts off below 100 Hz. A filter may be added to either channel by closing a solder switch, reducing the maximum frequency response to debounce contacts or for use with noisy signals. Both channels use a +1.2 volt reference. This may be increased to +2.4 volts by opening a solder switch to give increased noise rejection for higher-level signals.

The second building block is a dual one-shot multivibrator. The first one-shot has a delay of three microseconds. This delay is also the STORE interconnection to the Counter. STORE is connected by a solder switch on the Counter. The delay may be stretched to 3 milliseconds by closing a solder switch. This is the time required to preset the COUNTER or COMPARE registers in the Counter with a PRESET MODULE. The second one-shot has a delay of sixty milliseconds for operating relays. Solder switches allow reducing the delay to thirty milliseconds for burst counting of 50/60 Hz signals or to three microseconds for performing logic functions.

The third building block is a dual latch with SET and RESET inputs. These are useful in control applications. A typical example would be a coil winder. The Counter is preset to the number of turns required and the COMPARE register is set to a small number. The Counter is set to count down as the winding progresses. When the number in the COMPARE register is reached, the EQUAL output sets the first latch to slow the motor down. When the Counter reaches zero, the ZERO output sets the second latch to stop the motor.

The fourth block is a dual peripheral driver. These drivers can operate 12 volt DC relays to control external functions.

3.2.2 PERFORMANCE SPECIFICATIONS

3.2.2.1 SIGNAL INPUTS

3.2.2.1.1 Signal Conditioning Channel #1

3.2.2.1.2 Buffer In

This is a non-inverting signal with buffer output primarily used for contact closures to ground and 5V logic signals.

Input High	+2 to +75V
Input Low	-0.5 to +0.5V
Input Current	200µA maximum Low (sink) 1µA maximum High (source)
Frequency Response	DC to 200 KHz

The input levels change to the following with solder switch "A" open (+2.4V ref).

Input High	+3 to +75V
Input Low	-0.5 to +1.5V

The frequency response changes to the following with solder switch "E" closed. This feature is optimized for debouncing relays.

Frequency Response	50% duty cycle - DC to 150Hz 20% duty cycle - DC to 100Hz

3.2.2.1.3 Buffer Out

Output High	(Vs - 2V) minimum at 4mA source
Output Low	1.1V maximum at 4mA sink

3.2.2.2 Signal Conditioning Channel #2

3.2.2.2.1 AC Signal In

Input High (Count)	1.1V RMS (3V PP) to 20V RMS (56V PP)
Input Low (No Count)	0.35V RMS (1V PP) maximum
Maximum Amplitude	±100V, DC and peak AC
Input Impedance	3.9K ohms minimum
Frequency Response	100 Hz to 200 KHz (Larger amplitude signals extend count range below 100 Hz.)

3.2.2.2.2 DC Signal In

Input High	+2 to +20V
Input Low	-20V to +0.5V
Input Impedance	3.9K ohms minimum

3.2.2.2.3 Contact Closure In

This input is identical to the Buffer In (Par.3.2.2.1.2),except that Input High maximum equals +200V and solder switch "B" is closed for debouncing relays.

3.2.2.3 Comparator

Either the "+" or "-" input of the Comparator is normally connected to the Signal Conditioning Channel #2 (with the other input connected to the 1.2V reference), but it may be used separately with the following characteristics:

Input High	1.8V to (Vs - 2V)
Input Low	-0.5 to +1.0V
Input Impedance	+IN: 470K ohms -IN: 10 Megohms minimum
Frequency Response	DC to 200 KHz
Output High	4.7K to Vs
Output Low	0.5V maximum at 4mA sink

The input levels can be changed to the following with solder switch "A" open.

Input High	3.2V to (Vs - 2V)
Input Low	-0.5 to +2.4V

3.2.2.4 1.2V REFERENCE

+1.2V with Vs = 12V	+1.35V nominal
With Solder Switch "A" Open	+2.70V nominal

3.2.3 DELAY GENERATORS

The two delay generators are edge-triggered and are retriggerable. The 3.3µsec delay is used for setting Counter functions (RESET, STORE, etc.). The 2.9msec delay is used for presetting the Counter or Register. The 32msec delay is used for burst counting of 50/60Hz signals. It retriggers and delivers one pulse for each signal group. The 60msec delay is useful for momentary relay or solenoid closure.

3.2.3.1 Enable Inputs

Input High	80 to 100% of Vs
Input Low	0 to 20% of Vs
Impedance	Enable Delay - 100 K ohms to ground (NOT)Enable Delay - 100K ohms to ground

Rise or Fall Time	100µsec maximum

3.2.3.2 Output

Output High	(Vs - 1V) minimum at 2mA source
Output Low	+1V maximum at 2mA sink

3.2.3.3 Delay

Delay #1	3.3µsec ±30%
W/Solder Switch "G" Closed	2.9msec ±30%
Delay #2	60msec ±30%
W/Solder Switch "D" or "C" Closed	32msec ±30%
W/Solder Switch "C" & "D" Closed and "F" Open	3.3µsec ±30%

3.2.3.4 STORE

(NOT) Delay #1 OUT is connected to the STORE input of the Counter. A solder switch on the Counter must be connected to use STORE.

3.2.4 LATCHES

3.2.4.1 Set and Reset Inputs

Input High	80 to 100% of Vs
Input Low	0 to 20% of Vs
Impedance	100K ohms to ground

3.2.4.2 Outputs

Output High	(Vs - 1V) minimum at 2mA source
Output Low	1V maximum at 2mA sink

3.2.5 DRIVERS

3.2.5.1 Inputs

Input High	80 to 100% of Vs, 10μA maximum source
Input Low	0 to 20% of Vs, 360μA maximum sink

3.2.5.2 Outputs

Inductive loads should be diode-clamped or otherwise transient-suppressed to prevent exceeding the maximum voltage.

Supply Voltage	+56V maximum
Output Current	300mA maximum at +1.3V maximum

3.2.6 SOLDER SWITCHES

Solder bridges are used to change interval connections on the Signal Conditioner printed-circuit board. Solder switch A (closed) sets the REF OUT to +1.2V. Opening this switch (exacto knife) increases the output to +2.4V. Solder switch B (open) adds contact closure filtering to the CONTACT CLOSURE IN when closed. Solder switch E (open) adds contact closure filtering to BUFFER IN when closed. Solder switches C (open), D (open), and F (closed) determine the duration of DELAY #2 OUT. With F closed, the duration is 60 msec. Closing C or D and F results in 30 msec delay. If F is opened (exacto knife) and C and D are closed, the duration is 3 µsec Solder switch G (open) determines the duration of DELAY #2 OUT. When open, the delay is 3 µsec and when closed, the delay is 3 msec. The solder switches are located on the solder side of the printed circuit board and are closed by bridging with solder.

USE OF THIS PROPRIETARY INFORMATION IS RESTRICTED TO MAINTENANCE OF OUR PRODUCTS OR FABRICATION TO OUR ORDER.

CHG	E.O. NO.	DATES	BY	CHK
B	REL	2/29/80		
C	2379	4/7/80	AR	
D	2478	6/20/80	A.R.	

07082

P2
VS 7
STORE F 6
GND 8
OEI
C6 10µf
R20 100K
R19 2.2K
VS
PART OF P3
BUFFER IN 11
CR9
R8 10Ω
R11 4.7K
R13 470 K
R12 10 K
Q1 2N3904
C2 22pf
U1A
CR8
10 BUFFER OUT
E
C7 0.1
CR14
CR15
GND A
CR6 CR5 CR4 CR3
AC SIGNAL IN N
C3 0.47µF
A
C4 4.7µF
12 1.2V REF OUT
R2
C5 0.1
CR1 IN270
B
CR2
R4 100 K
DC SIGNAL IN P
R1 3.9K,1/2 W
CONTACT CLOSURE IN S
CR7 IN486
R3 10Ω
R CLAMPED SIG OUT
+ COMPARATOR IN 15
R7 4.7 K
R6 470 K
R5 4.7 K
C1 22pf
U1B
− COMPARATOR IN 14
13 COMPARATOR OUT
DRIVER #1 IN K
U2A
J (NOT) DRIVER #1 OUT
DRIVER #2 IN L
U2B
M (NOT) DRIVER #2 OUT

PART OF P3
LATCH #1 SET 5
R16 100K
LATCH #1 RESET B 4
CR12
LATCH #1 RESET A 3
CR13
LATCH #2 SET 7
U3A
PART OF P3
1 LATCH #1 OUT
2 (NOT) LATCH #1 OUT
R17 100K
R10 100K
U3B
6 LATCH #2 OUT
LATCH #2 RESET A 8
CR11
LATCH #2 RESET B 9
CR10
R23 23.2K,1% 1/8 W
R9 100K
C11 .33
C10 100pf
ENABLE DELAY E
(NOT) ENABLE D DELAY #1
U4A
C DELAY #1 OUT
B (NOT) DELAY #1 OUT
R21 100 K
R22 100K
E2
R24 158K,1% 1/8 W
D
R14 158K,1% 1/8 W
C
R15 23.2K,1% 1/8 W
C8 0.47
C9 100pf
ENABLE DELAY #2 H
R18 100 K
U4B
F DELAY

6 OPTION SC3 REQUIRES TOTALIZER 6221 ST OR 6222 ST.
5 CLOSED AFTER FINAL TEST.
4 DIODES IN4448
3 REFERENCE PARTS LIST 07080-01,-02,-03.
2 CAPACITORS VALUED IN MICROFARADS
1 RESISTORS VALUED IN OHMS, ±5%, 1/4 W
NOTES: UNLESS OTHERWISE SPECIFIED

PART OF P3

SC3 6	07080-03	B,E,F,G	A,C,D
SC2	07080-02	C,D,G	A,B,E,F
SC1	07080-01	B,C,D,E,G	A,F
OPTION	P/L NO.	OPEN	CLOSED
		SOLDER CONNECTION	

REF DESIG.	NE1	TYPE	VS	GND
U4	49823	CD4098	16	8
U3	49756	CD4013	14	7
U2	49837	DS3632	8	4
U1	49775	LM393	8	4

	BY	DATE
DR	LBROE	11/13/79
CHK		
APPD		9/25/80
FINISH		

NEWPORT LABORATORIES, INC.
630 E. YOUNG STREET
SANTA ANA, CALIFORNIA 92705

TITLE
SCHEMATIC, (OPTION SC)
SIGNAL CONDITIONER

SIZE	CODE IDENT NO.	NO.
D	32873	07082

SCALE NONE | MODEL 6220 | SHEET 1 OF 1

07082

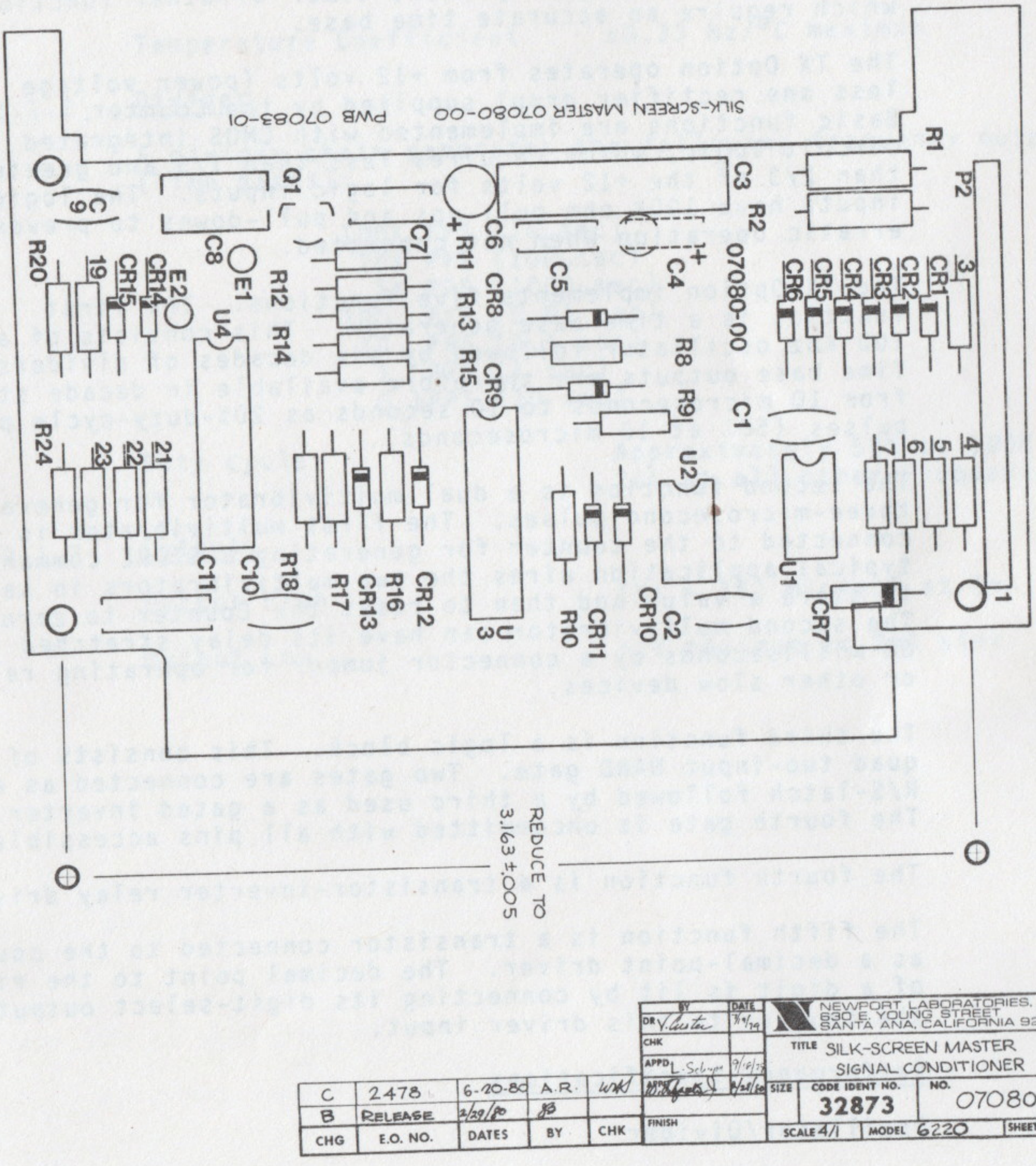
3.2.7 PIN ASSIGNMENTS

OPTION SC - SIGNAL CONDITIONER

P3-1	LATCH #1 OUT	P3-A	GND
-2	(NOT) LATCH #1 OUT	-B	(NOT) DELAY #1 OUT
-3	LATCH #1 RESET A	-C	DELAY #1 OUT
-4	LATCH #1 RESET B	-D	(NOT) ENABLE DELAY #1
-5	LATCH #1 SET	-E	ENABLE DELAY #1
-6	LATCH #2 OUT	-F	DELAY #2 OUT
-7	LATCH #2 SET	-H	ENABLE DELAY #2
-8	LATCH #2 RESET A	-J	(NOT) DRIVER #1 OUT
-9	LATCH #2 RESET B	-K	DRIVER #1 IN
-10	BUFFER OUT	-L	DRIVER #2 IN
-11	BUFFER IN	-M	(NOT) DRIVER #2 OUT
-12	1.2V REF OUT	-N	AC SIGNAL IN
-13	COMPARATOR OUT	-P	DC SIGNAL IN
-14	- COMPARATOR IN	-R	CLAMPED SIG OUT
-15	+ COMPARATOR IN	-S	CONTACT CLOSURE IN

INTERCONNECTIONS TO OPTION CARD

P2-6	STORE
-7	Vs
-8	GND



BY	DATE
DR Y. Custer	7/9/79
CHK	
APPD L. Schuyler	9/18/79
APPD	9/28/80
FINISH	

NEWPORT LABORATORIES, INC.
630 E. YOUNG STREET
SANTA ANA, CALIFORNIA 92705

TITLE SILK-SCREEN MASTER
SIGNAL CONDITIONER

SIZE	CODE IDENT NO.	NO.
	32873	07080-00

SCALE 4/1 | MODEL 6220 | SHEET 1 OF 1

CHG	E.O. NO.	DATES	BY	CHK
C	2478	6-20-80	A.R.	WKS
B	RELEASE	2/29/80	BB	

3.3 TX OPTIONS

3.3.1 Functional Description

The TX Option interconnects with the Model 6221/6222 Counter and mounts in the same case. By appropriate connector jumpers and interconnects to the counters, the TX Option can be used to form a frequency counter, stopwatch, accumulating stopwatch, timer or other functions which require an accurate time base.

The TX Option operates from +12 volts (power voltage less one rectifier drop) supplied by the Counter. Basic functions are implemented with CMOS integrated circuit logic, which requires less than 1/3 and greater than 2/3 of the +12 volts for logic inputs. The logic inputs have 100K ohm pull-ups and pull-downs to prevent erratic operation when not connected.

The TX Option implements five functions. The first function is a time base generator. This consists of a 100 KHz oscillator followed by six decades of dividers. Time base outputs are therefore available in decade steps from 10 microseconds to 10 seconds as 20%-duty-cycle positive pulses (50% at 10 microseconds).

The second function is a dual multivibrator for generating three-microsecond pulses. The first multivibrator is also connected to the counter for generating a STORE command. A typical application wires the two multivibrators in series to store a value and then to reset the Counter to zero. The second multivibrator can have its delay stretched to 60 milliseconds by a connector jumper for operating relays or other slow devices.

The third function is a logic block. This consists of a quad two-input NAND gate. Two gates are connected as an R/S-latch followed by a third used as a gated inverter. The fourth gate is uncommitted with all pins accessible.

The fourth function is a transistor-inverter relay driver.

The fifth function is a transistor connected to the counter as a decimal-point driver. The decimal point to the right of a digit is lit by connecting its digit-select output from the Counter to this driver input.

3.3.2 Performance Specifications

3.3.2.1 Oscillator/Divider

3.3.2.1.1 Oscillator

The oscillator uses a watch-type 100 KHz quartz crystal to generate stable time bases.

Frequency:	
XT1 Option	100 KHz ±5 Hz at 25°C
XT2 Option	100 KHz ±1.0 Hz at 25°C
Temperature Coefficient	±0.33 Hz/°C maximum

3.3.2.1.2 Divider

A divider chain generates the following frequency outputs (Time Bases):

100K PPS (10μsec)
10K PPS (100μsec)
1K PPS (1000μsec)
100 PPS (0.01 sec)
10 PPS (0.1 sec)
1 PPS (1 sec)
0.1PPS (10 sec)

Duty cycle	Approximately 50% at 100K PPS, 20% at all other frequencies

3.3.2.1.3 Outputs

Output High	(Vs - 1V) minimum at 2mA source
Output Low	+1V maximum at 2mA sink

3.3.2.1.4 Reset Input

Input High	80 to 100% of Vs
Input Low	0 to 20% of Vs
Input Impedance	100K ohms to ground

3.3.2.2 LOGIC

A quad two-input NAND CMOS gate IC is used for performing logic functions. Two gates are connected as a latch with a third connected to the output for gating signals. The fourth gate is uncommitted with all leads brought out.

Input High	80 to 100% of Vs
Input Low	0 to 20% of Vs
Input Impedance	100K ohms to Vs
Output High	(Vs - 1V) minimum at 2mA source
Output Low	+1V maximum at 2mA sink

3.3.2.3 DELAY GENERATORS

The delay generators are edge triggered and are retriggerable. The 3.3μsec delay is used for setting the Counter functions (RESET, STORE, etc.). The 60 msec delay is used for momentary relay or solenoid closures.

3.3.2.3.1 Enable Inputs

Input High	80 to 100% of Vs
Input Low	0 to 20% of Vs
Impedance	Enable delay: 100K ohms to ground (NOT)Enable delay: 100K ohm to Vs

3.3.2.3.2 Output

Output High	(Vs - 1V) minimum at 2mA source
Output Low	+1V maximum at 2mA sink

USE OF THIS PROPRIETARY INFORMATION IS RESTRICTED TO MAINTENANCE OF OUR PRODUCTS OR FABRICATION TO OUR ORDER.

CHG	E.O. NO.	DATES	BY	CHK
C	2610	10-8-80	A.R.	
B	REL	6/9/81		

07222

PART OF P3
(NOT) SIG OUT 10
SIG IN 11
(NOT) START N
(NOT) STOP P
RUN R
(NOT) DRIVER OUT L
NAND IN A 14
NAND IN B 15
NAND OUT 13
(NOT) DRIVER IN M
DEL 2 OUT H
STRETCH 2A 12
STRETCH 2B 8
DP DRIVE IN S
GND A
(NOT) ENABLE DEL 1 E
ENABLE DEL 1 D
DEL 1 OUT C
(NOT) DEL 1 OUT B
(NOT) DEL 2 OUT F
(NC) ENABLE DEL 2 J
ENABLE DEL 2 K

R9 100K +12V
R8 100K
R10 100K
U1
R4 100K
R13 100K
R5 2.2K
CR1 IN4448
Q1 2N5769
Q2 2N5769
R6 22K
R7 4.7K
Q3 2N5769
R3 82
P2 GND 14 8
+12V STORE 7 6
C5 1μ
R12 100K
C2 100pF
R2 22.6K,1%,1/8W
U2
R11 100K
C1 6.8
R14 100K
C3 100pF
R1 22.6K 1%,1/8W
R15 100K
R16 150K
R17 470K
R18 82K
R20 22M
XT1 ③
C4 5-25 pf ③
C7 ⑤
C8 ⑤
C6 ⑤
U6
N.C.

1 100K PPS
2 10K PPS
3 1K PPS
4 100 PPS
5 10 PPS
6 1 PPS
7 0.1 PPS
9 TIMER RESET
U5
U4
U3
R19 100K
PART OF P3

1,2,6,7,8,9,10,14,15,16

5. SELECT IN TEST.
4. REF GRADING PROCEDURE 07228
3. SEE PARTS LIST 07220-01,-02
2. CAPACITORS VALUED IN MICROFARADS
1. RESISTORS VALUED IN OHMS, ±5%, 1/4 W
NOTE: UNLESS OTHERWISE SPECIFIED

REF DESIGN	NEI P/N	TYPE	GND	+12V
U1	49724	CD4011BE	7	14
U2	49823	CD4098BE	8	16
U3,4,5	49822	CD4518BE	8	16
U6	49695	CD4007BE	7	14

LAST REFERENCE DESIGNATION USED: R20, C8, CR1, U6, Q3, XT1, P3

BY	DATE
DR V.B202	11/15/79
CHK	
APPD	
APPD	6/9/80
FINISH	

NEWPORT LABORATORIES, INC.
630 E. YOUNG ST. SANTA ANA, CALIF. 92705

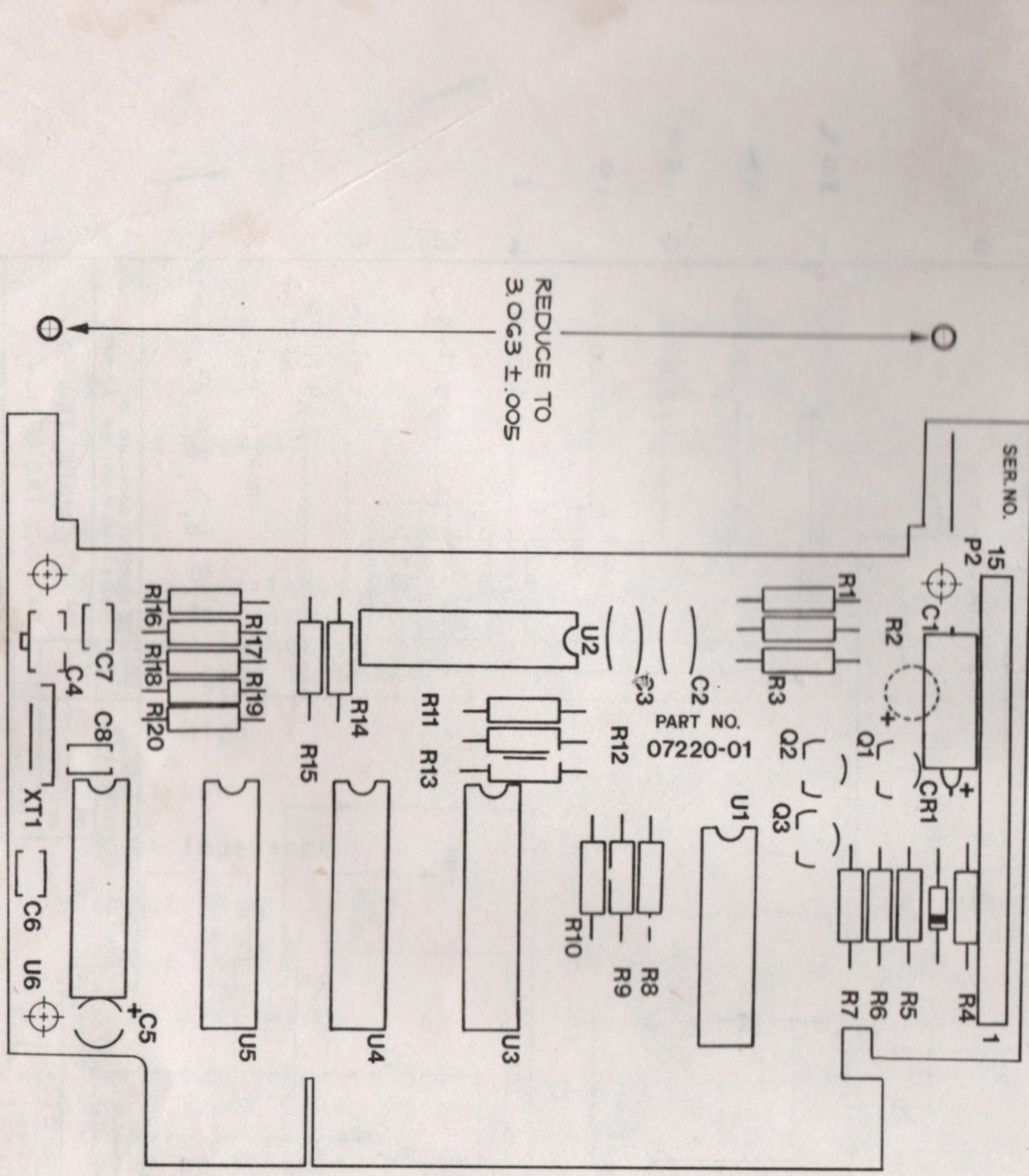
TITLE SCHEMATIC DIAGRAM
TX1 AND TX2 OPTION

SIZE	CODE IDENT	NO.
C	32873	07222

SCALE | MODEL 6221/6222 | SHEET 1 OF 1

DIETERICH-POST CLEARPRINT 1000H-10

(F) RESET (B) STORE



P.W.B. 07223-01
S.S.M. 07220-00

4. RUBBER STAMP APPROPRIATE SERIAL NO. APPROXIMATELY WHERE SHOWN.
3. REF. SCHEMATIC NO. 07222
2. REF. PARTS LIST NO. 07220-01,-02.
1. ASSEMBLE PER WORKMANSHIP MANUAL

NOTES: UNLESS OTHERWISE SPECIFIED

CHG	E.O. NO.	DATES	BY	CHK
C	RELEASE	1-1-84	[illegible]	

BY	DATE
DR ARSENIO	6/18/84
CHK	
APPD L.S	9/14
APPD	
FINISH	

NEWPORT LABORATORIES, INC.
630 E. YOUNG STREET
SANTA ANA, CALIFORNIA 92705

TITLE ASSEMBLY, PRINTED CIRCUIT BOARD, COUNTER/TIMER

SIZE	CODE IDENT NO.	NO.
C	32873	07220-00

SCALE 4:1 | MODEL 6220 | SHEET 1 OF 1

3.3.2.3.3 Delay

Delay #1 & #2	3.3µsec ±20% at 25°C 3.3µsec ±30% temp & life
Delay #2 Stretched (Stretched 2A connected to 2B)	60msec ±20% at 25°C 60msec ±30% temp & life

3.3.2.3.4 STORE

The (NOT) Delay output of Delay #1 is interconnected to STORE on the Counter. Solder switches must be changed on the Counter if this function is used.

3.3.2.4 DRIVER

A diode-suppressed 12V relay driver is provided.

Input High	+2.5 to +50.0V
Input Low	0 to 0.5V
Input Impedance	22K ohms
Output Current	100mA sink at 1V maximum

3.3.2.5 DECIMAL POINT

A DP Drive input is provided. When a digit-select output from the Counter is connected to this point, the decimal point to the right of that digit will be lit on the Counter display.

3.3.3 PIN ASSIGNMENTS

OPTION TX - COUNTER/TIMER

P3-1	100K PPS	P3-A	GND
-2	10K PPS	-B	(NOT) DEL 1 OUT
-3	1K PPS	-C	DEL 1 OUT
-4	100 PPS	-D	ENABLE DEL 1
-5	10 PPS	-E	(NOT) ENABLE DEL 1
-6	1 PPS	-F	(NOT) DEL 2 OUT
-7	0.1 PPS	-H	DEL 2 OUT
-8	STRETCH 2B	-J	(NOT) ENABLE DEL 2
-9	TIMER RESET	-K	ENABLE DEL 2
-10	(NOT) SIG OUT	-L	(NOT) DRIVER OUT
-11	SIG IN	-M	(NOT) DRIVER IN
-12	STRETCH 2A	-N	(NOT) START
-13	NAND OUT	-P	(NOT) STOP
-14	NAND IN A	-R	RUN
-15	NAND IN B	-S	DP DRIVE IN

INTERCONNECTIONS TO COUNTER - 6221/6222

P2-6	STORE
-7	+12V
-8	GND
-14	DECIMAL POINT

USE OF THIS PROPRIETARY INFORMATION IS RESTRICTED TO MAINTENANCE OF OUR PRODUCTS OR FABRICATION TO OUR ORDER.

CHG	E.O. NO.	DATES	BY	CHK
A	REL	2/27/80	VB	

07087

P1

LOAD COUNTER 4
LOAD REGISTER 5
DIGIT SELECT 1 IN L
DIGIT SELECT 2 IN K
DIGIT SELECT 3 IN J
DIGIT SELECT 4 IN H
DIGIT SELECT 5 IN F
DIGIT SELECT 6 IN E
+12 VDC 9
GROUND 10
PRESET BCD 1 A
PRESET BCD 2 B
PRESET BCD 4 C
PRESET BCD 8 D

LDC
LDR
DS1
DS2
DS3
DS4
DS5
DS6
BCD 1
BCD 2
BCD 4
BCD 8

PART OF SWITCH BD
UP
Vs
S13

W1 W2 W3 W4 W5 W6 (5)
R2 10K
R1 10K
U3A
U3B
U2
U1

VS
CR49
C1 10 25V
C2 C3 C4 C5 150 pF 150 pF 150 pF 150 pF

SWITCH BOARD
S1 S2 S3 S4 S5 S6 S7 S8 S9 S10 S11 S12

(5) W1 THRU W6 FOR SINGLE PRESET ONLY
4. REFERENCE PARTS LIST NO. 07085-01,-02
3. ALL DIODES ARE 47000
2. CAPACITORS VALUED IN MICROFARADS
1. RESISTORS VALUED IN OHMS ±5%, ¼
NOTE: UNLESS OTHERWISE SPECIFIED

REF DES	NEI P/N	TYPE	+12V	GND
U3	49756	4013	14	7
U1, 2	49826	14503	16	8

UNLESS OTHERWISE SPECIFIED DIMENSION TOLERANCES ARE:

	MM	IN
X	1.3	—
.X	.5	.1
.XX	.25	.02
.XXX	—	.010

ANGLES ± 0° 30'

DO NOT SCALE PRINT

MATERIAL

FINISH

BY	DATE
DR V. BROZ	1/21/80
CHK	
APP	2/26/80
APPD	

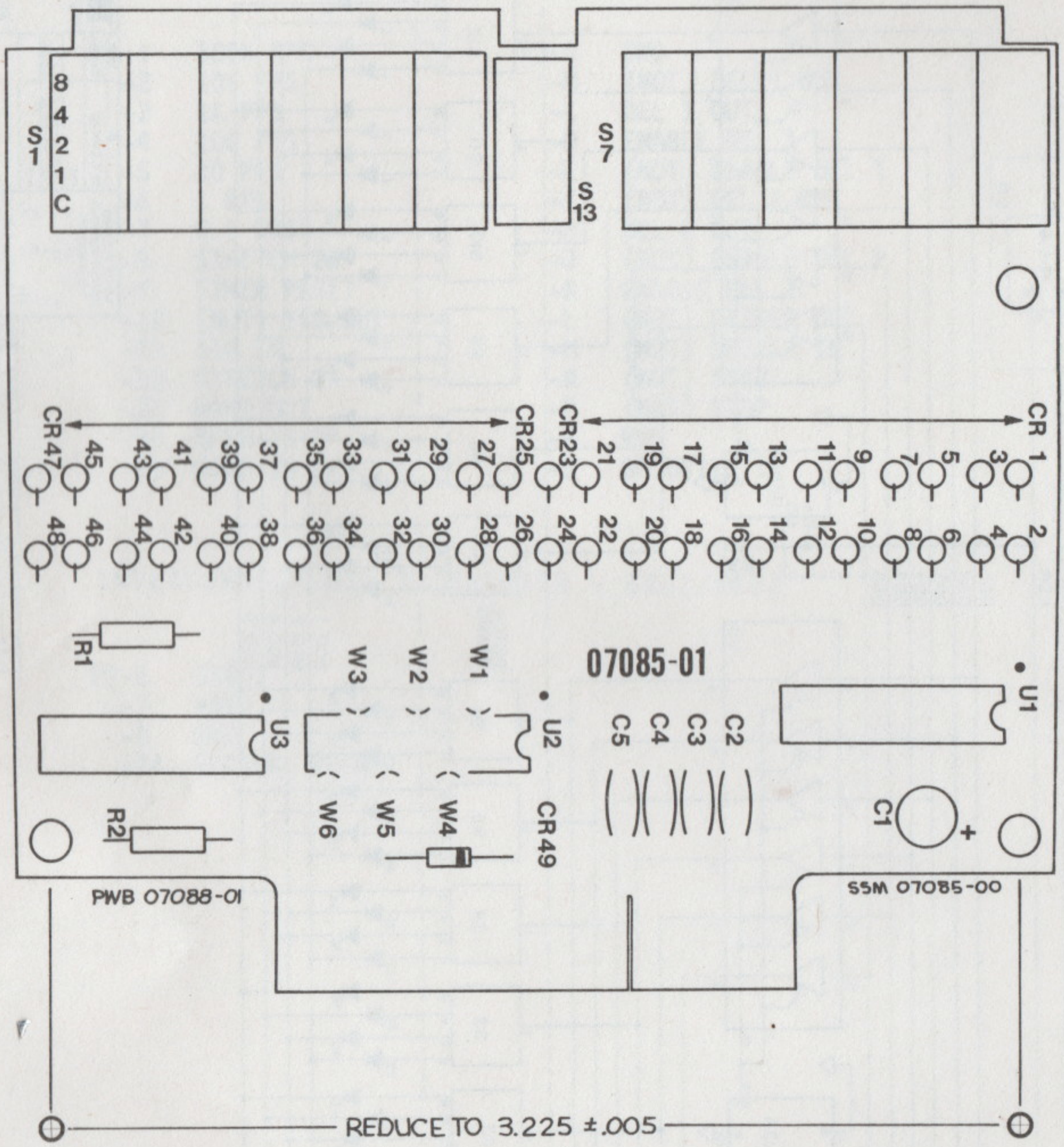
NEWPORT LABORATORIES, INC.
630 E. YOUNG STREET
SANTA ANA, CALIFORNIA 92705

TITLE
SCHEMATIC DIAGRAM
PRESET MODULE

SIZE	CODE IDENT NO.	NO.
D	32873	07087

SCALE | MODEL 6227 AND 6228 | SHEET 1 OF 1

9/77 DIETERICH-POST CLEARPRINT 10004-30



1. REMOVE TABS ON S12

BY	DATE
DR. R FOLEY	7-3-1979
CHK	
APPD	9/4/80
APPD	

NEWPORT LABORATORIES, INC.
630 E. YOUNG STREET
SANTA ANA, CALIFORNIA 92705

TITLE ASSEMBLY, P.W.B. - PRESET MODULE

SIZE	CODE IDENT NO.	NO.
	32873	07085-00

SCALE 4/1 | MODEL 6227/6228 | SHEET 1 OF 1

CHG	E.O. NO.	DATES	BY	CHK	FINISH
B	RELEASE	2/27/80			

3.4 6223/6224 PRESET MODULES

3.4.1 Functional Description

The Preset Assembly is a companion DIN III module to the Counter. It is available in two models: a Single Preset, Model 6223, which contains one group of six thumbwheel switches; and a Dual Preset, Model 6224, which contains two groups of six thumbwheel switches. A three-position toggle switch (spring return to center position) or an external control is used to load the counter and/or the COMPARE register in the Counter.

3.4.2 Performance Specification

3.4.2.1 Wiring

A prewired six-inch cable to the counter is available for use with either Preset Assembly as option CC4. Cable connections are listed in para. 3.4.3. Any of the Signal Conditioning options to the Counter may be used.

3.4.2.2 Single Preset Model

The thumbwheel-switch setting presets the Counter when the toggle switch is pushed upward and it loads the COMPARE register when pushed downward. When both functions are used, the thumbwheel switch settings must be reset between loadings.

3.4.2.3 Dual Preset Model

The left thumbwheel-switch setting loads the counter when the toggle switch is pushed upward. The right thumbwheel-switch setting is loaded into the COMPARE register when the toggle switch is pushed downward.

3.4.2.4 External Loading Control

Control Lines	Load Counter (LDC) Load Register (LDR)
Timer Required	2 msec minimum
Input High	(Vs - 1V) minimum (e.g., use a delay generator or logic from a Signal Conditioner care in the Counter module)
Input Low	0 to 20% of Vs
Input Impedance	10K ohms to ground

3.4.2.5 POWER

The Preset Module is wired in parallel with the +12 volt power supply that powers the Counter. It also uses a rectifier in series with the power supply voltage to prevent damage from polarity reversal of the power.

3.4.3 CC4 Cable Wire List

SYMBOL	PRESET 6223, 6224 PIN NO. J1	TOTALIZER 6221, 6222 PIN NO. J1	DESCRIPTION
LDC	4	4	Load Counter
LDR	5	5	Load Register
+12V	9	9	+12V
GND	10	10	GND
PR1	A	A	BCD 1
PR2	B	B	BCD 2
PR4	C	C	BCD 4
PR8	D	D	BCD 8
DS6	E	E	Digit Select 6
DS5	F	F	Digit Select 5
DS4	H	H	Digit Select 4
DS3	J	J	Digit Select 3
DS2	K	K	Digit Select 2
DS1	L	L	Digit Select 1

3.5 6225 POWER SUPPLY

3.5.1 Functional Description

The Model 6225 Power Supply is an unregulated +12 Volt power supply for operating 6220 system components. It comes in two versions, -1 for 115V RMS input and -2 for 230V RMS input. It is intended for behind-the-panel mounting.

3.5.2 Performance Specifications

3.5.2.1 Input

Voltage . . . . . .115/230V RMS, ±10%

Frequency 50/60Hz

Power . . . . . 10 Watts Max.

3.5.2.2 Output

DC Volts. . . . . +15.5V Max @ 150mA load

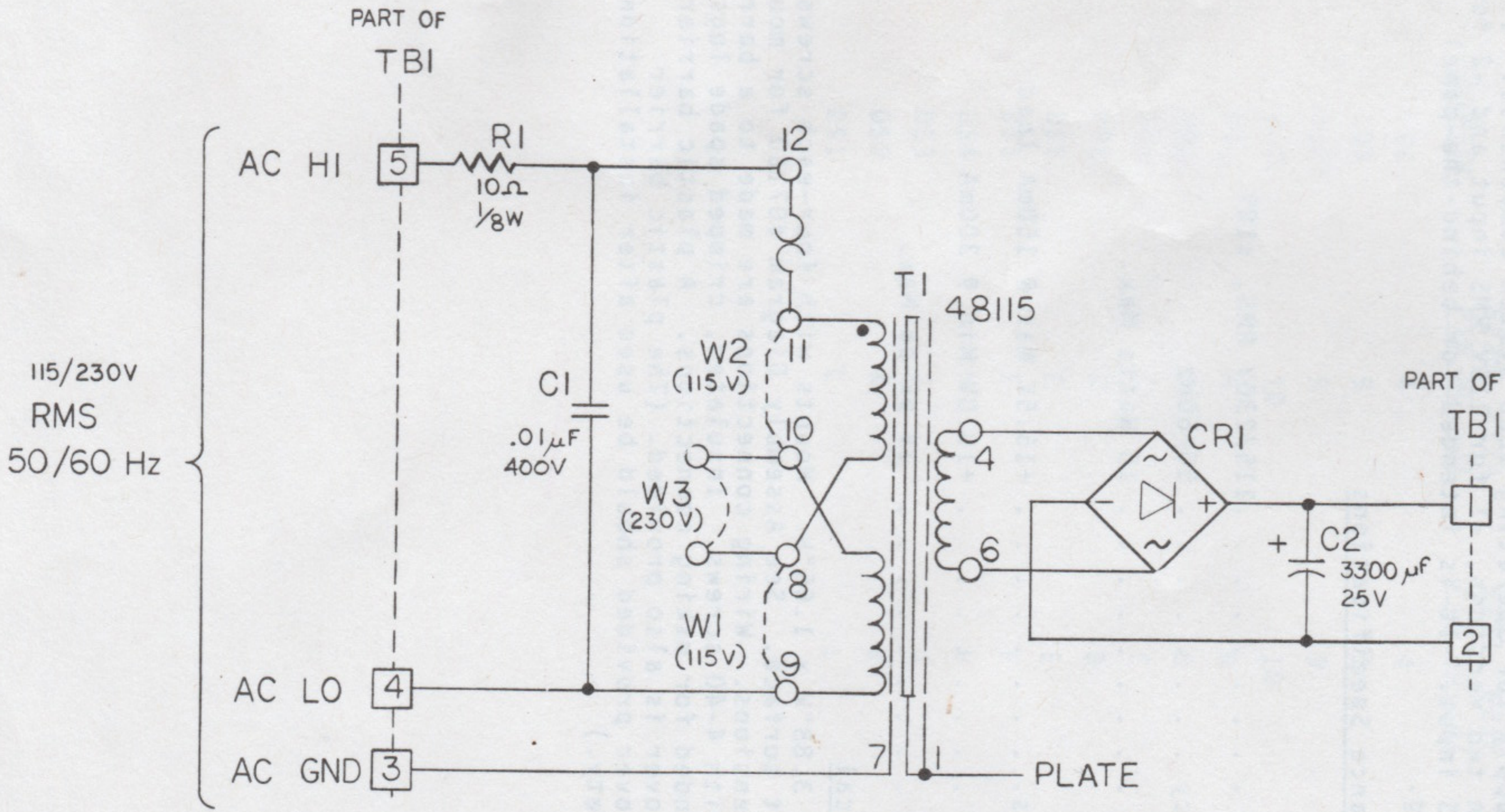
. . . . . +10.0V Min @ 300mA

Ripple. . . . . 1V pk-pk Max.

3.5.3 Mechanical

5.4"L x 3.88"W x 1.66"H. Mounts with four-each screws to any flat surface. See Assembly Diagram #07160 for mounting dimensions. Wiring connections are made to a barrier strip with 4-40 screws. Insulated, crimped spade lugs are recommended for making connections. A plastic barrier strip cover is also provided. (The plastic barrier strip cover provided should be used after installation for safety.)

CHG	E.O. NO.	DATES	BY	CHK
A	REL	8/22/79	VB	VC



2. REFERENCE ASSEMBLY DIAGRAM NO. 07155-00.

1. REFERENCE PARTS LISTS NO. 07155-01 (115V), -02 (230V)

NOTE: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED:	BY	DATE
TOLERANCES .X ±.05 ANGULAR ±0° 30' .XX ±.02 .XXX ±.010 ✓ THREADS CLASS 2A OR 2B REMOVE BURRS AND SHARP EDGES .02 MAX. DO NOT SCALE DWG.	DR V. BROZ	8/22/79
	CHK J. Custer	9/21/79
	APPD B. Fu	9/16/80
MATERIAL	USE OF THIS PRORIETARY INFORMATION IS RESTRICTED TO MAINTENANCE OF OUR PRODUCTS OR FABRICATION TO OUR ORDER.	
FINISH		

NEWPORT LABORATORIES, INC.
630 E. YOUNG ST. SANTA ANA, CALIF. 92705

TITLE DC POWER SUPPLY
12 VOLTS, SCHEMATIC

CODE IDENT	SIZE	NO.
32873	B	07157

SCALE NONE | MODEL 6225 | SHEET 1 OF 1

10/72 DIETERICH-POST CLEARPRINT 1000H-10

TABLE I

APPLICATION NOTES

SYSTEM 6220

APPLICATION NOTE NO	APPLICATION	MODULES REQUIRED	OPTIONS AND NOTES
215	UP/DOWN (BI-DIRECTIONAL) TOTALIZER	6222	
216	PRESET UP/DOWN COUNTER	6222 6223	CC4
217	PRESET UP/DOWN CONTROLLER	6222 6223	CC4
218	FREQUENCY COUNTER	6222-ST	TX1 or TX2
219	STOPWATCH OR ACCUMULATING STOPWATCH	6222-ST	TX1 or TX2
220	PRESET TIMER (4 OPERATING MODES)	6221 or 6222 6223	TX1 or TX2, EXTERNAL RELAY CC4
221	PRESCALING COUNTER	6221 6222-ST 6223	TX1 or TX2 CC4
222	FACTORING COUNTER	6221 6222-ST 6223	 TX1 or TX2 CC4
223	DIGITAL RATIOMETER	6221 6222-ST 6223	 SC3 CC4
224	DIFFERENTIAL SPEED MONITOR	6221 6222-ST 6223	SC3 TX 1 or TX 2 CC4

APPLICATION NOTE
NUMBER 215

UP/DOWN TOTALIZER

SYSTEM 6220

The Model 6222 Totalizer is the simplest stand-alone member of the 6220 family. It can count either plus or minus the number of events since the last reset. These events can be contact closures or digital logic transitions. The 6222 counts negative-going transitions from +2 to +0.5 volts. Useful count rate is DC to 1 MHz, although this may be limited by other logic considerations.

The basic UP/DOWN counter connections are shown in Figure 1. To count up, all that is required is a power supply and signal connections plus connecting pins 4 and 5 to ground. UP/DOWN control is added by connecting a switch to Pin 1. When counting up, the 6222 "rolls over" from 999999 to 000000, repeating the upward counting cycle. When counting down, the 6222 "rolls under" from 000000 to 999999 (10's complement negative numbers), continuing to repeat the downward counting cycle. External RESET control can be added by connecting a switch from Pin 8 to ground. Count INHIBIT control is added by connecting a switch between Pin 3 and +12 volts with a 4.7K-ohm current-limiting resistor. The RESET switch may be replaced be most standard digital logic. The UP/DOWN and INHIBIT switches can be replaced by high-voltage open-collector logic or transistors. The INHIBIT connection requires the 4.7K-ohm resistor to +12 volts and the collector to Pin 3.

Relay and switch contacts bounce on closure, which can result in spurious counts. By adding the two resistors shown in Figure 2, the spurious counts are eliminated for most switches and fast relays. The capacitor value can be increased for even slower-acting devices. The 100K-ohm resistor supplies the pull-up current required for counting. The 100-ohm resistor limits the contact current to a safe value. RESET and other controls may be added as shown in Figure 1.

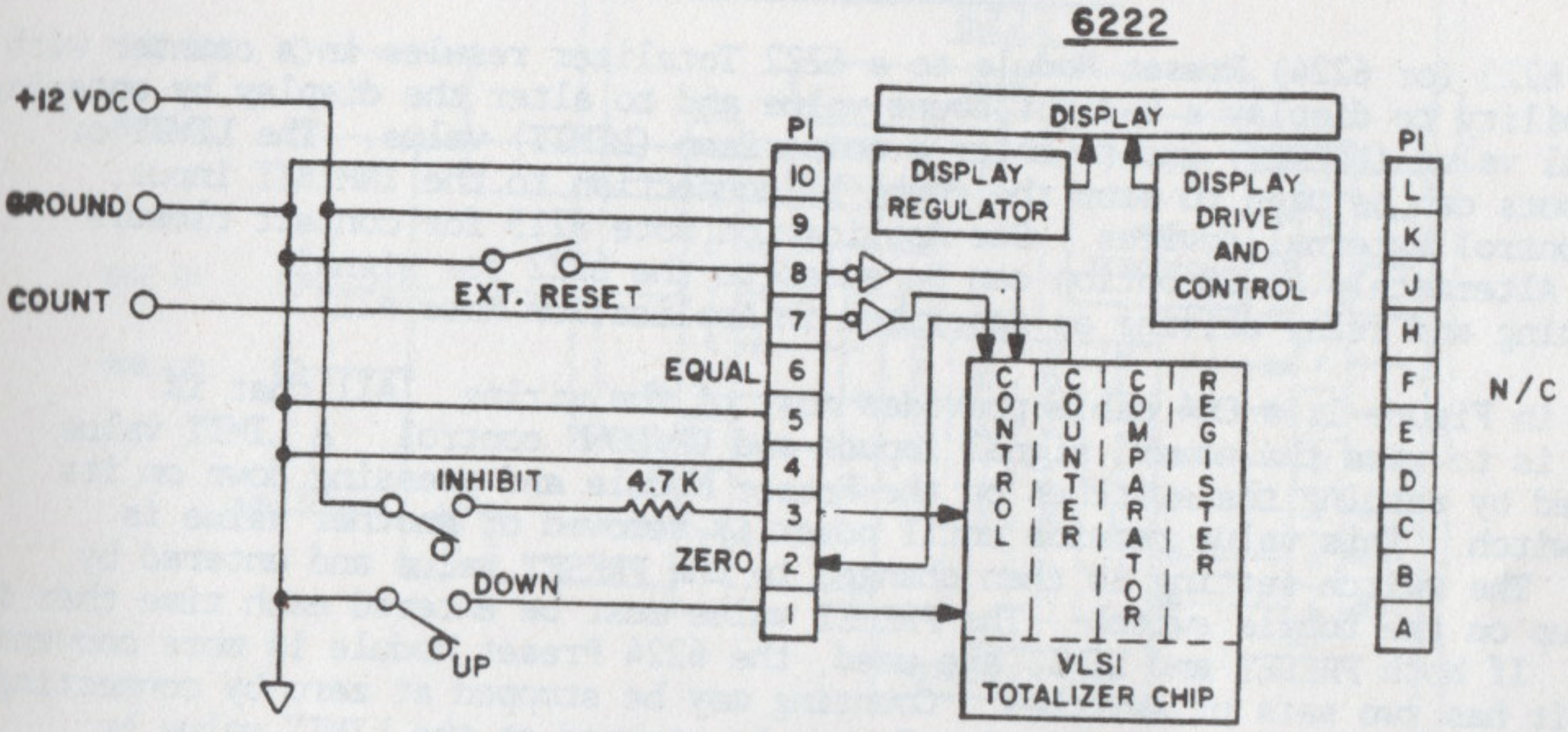


FIGURE 1

UP/DOWN COUNTER
(0 to 999999)

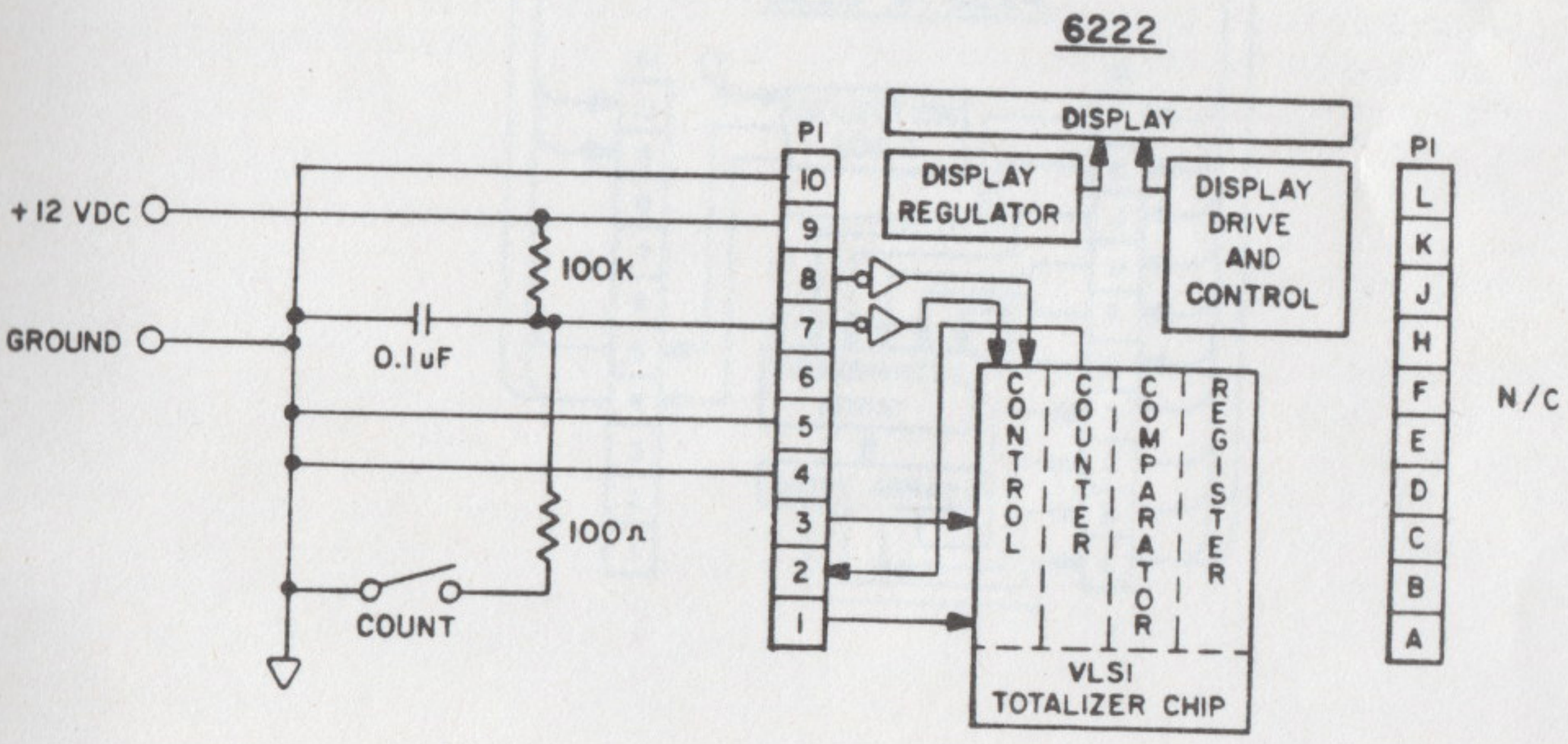


FIGURE 2

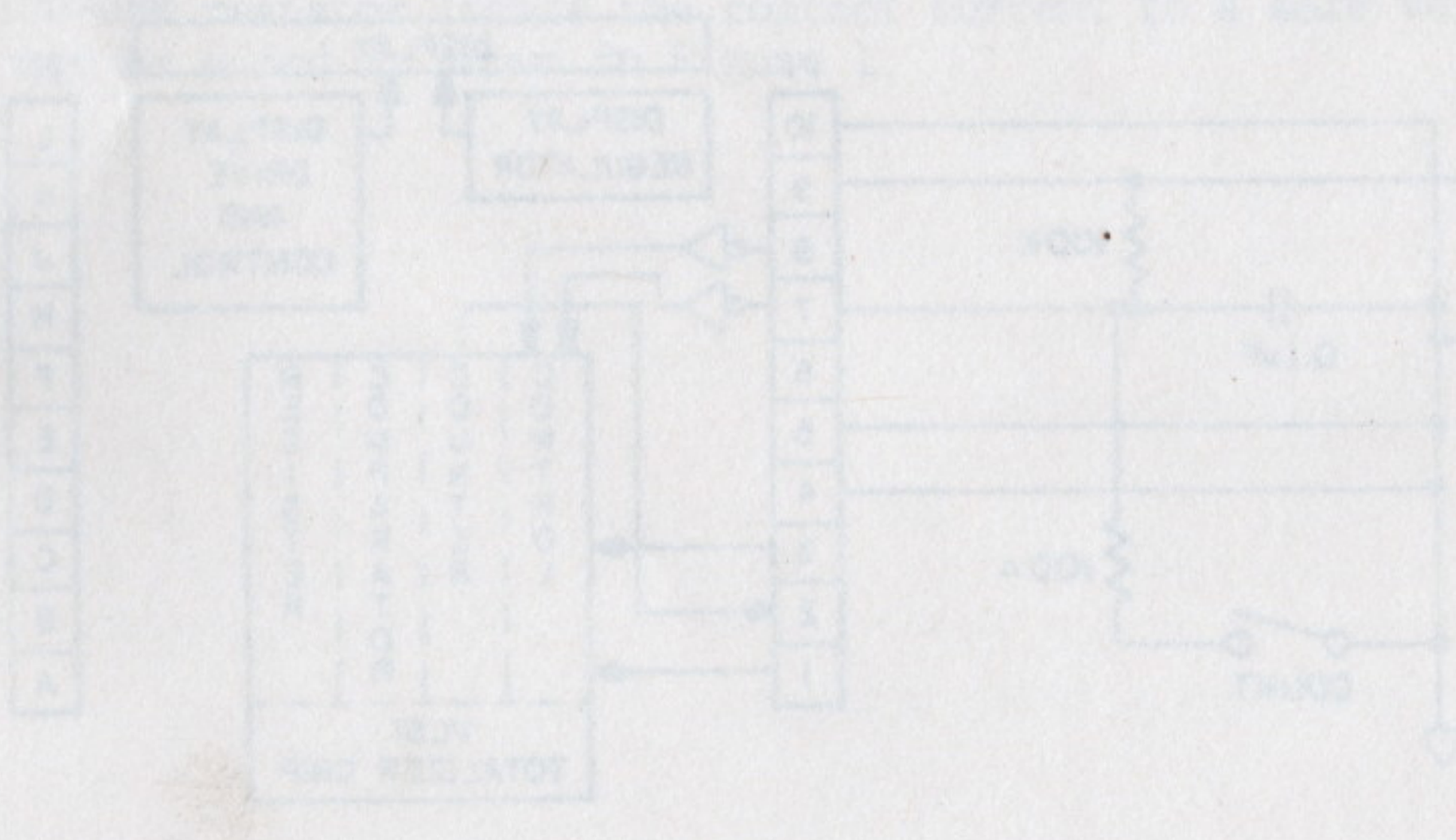
CONTACT-CLOSURE COUNTER
(0 to 999999)

APPLICATION NOTE
NUMBER 216

PRESET UP/DOWN COUNTER

Adding a 6223 (or 6224) Preset Module to a 6222 Totalizer results in a counter with the capability to display a 6-digit count value and to alter the display by entering an initial value (PRESET) and to enter a comparison (LIMIT) value. The LIMIT or ZERO outputs can be used to stop the count by connection to the INHIBIT input, and to control external devices. See Application Note #215 for contact closure inputs. Alternately an SC option can be added to the 6222 for signal conditioning and relay driving as described in Application Note #217.

As shown in Figure 1, a CC4 cable provides most of the wiring. All that is required is to wire the power, signal inputs and UP/DOWN control. A LIMIT value is entered by setting the switches on the Preset Module and pressing down on its toggle switch. This value remains until power is removed or another value is entered. The switch setting is then changed to the PRESET value and entered by pushing up on the toggle switch. The PRESET value must be entered each time that it is used. If both PRESET and LIMIT are used, the 6224 Preset Module is more convenient because it has two sets of switches. Counting may be stopped at zero by connecting ZERO output, Pin 2 to INHIBIT, Pin 3. It may be stopped at the LIMIT value by connecting the EQUAL output, Pin 6, to INHIBIT. The INHIBIT is removed when the preset is re-entered.



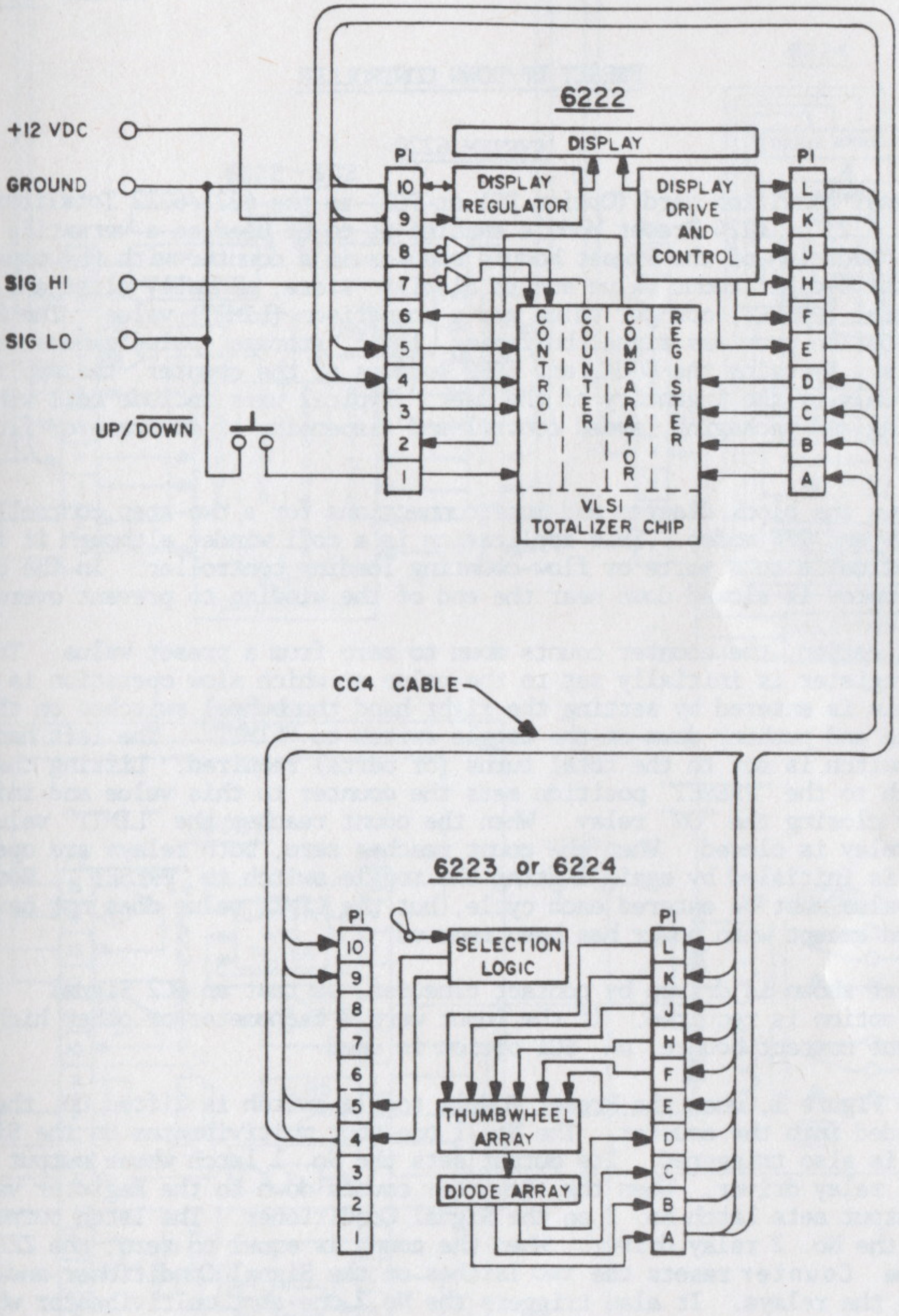


FIGURE 1

PRESET UP/DOWN COUNTER

(0 to 999999)

APPLICATION NOTE
NUMBER 217

PRESET UP/DOWN CONTROLLER

SYSTEM 6220

Adding a signal condition card (Option SC1 or SC2) to the 6221/6222 Totalizer and connecting a 6223 or 6224 Preset Module enables it to be used as a versatile controller. Addition of the Preset Module results in a counter with the capability to display the 6-digit count value and to display, store, manually alter and enter both an initial (PRESET) counter value and a comparison (LIMIT) value. The Signal Conditioner option provides signal buffering, logic, storage, pulse generators and relay drivers. By using the EQUAL and ZERO outputs of the counter, the applications are limited only by the ingenuity of the user. Typical uses include coil winding, parts counting and packaging, speed control and dispensing of discrete or fluid materials.

Figure 1 shows the block diagram and interconnections for a two-step controller with ON, SLOW and OFF modes. This application is a coil winder although it is directly applicable to a parts or flow-counting loading controller. In the coil winder, the motor is slowed down near the end of the winding to prevent overwinding.

In this application, the counter counts down to zero from a preset value. The comparison register is initially set to the value at which slow operation is desired. This is entered by setting the right hand thumbwheel switches on the Preset Module and pushing down on the toggle switch to "LIMIT". The left hand thumbwheel switch is set to the total turns (or parts) required. Lifting the toggle switch to the "PRESET" position sets the counter to this value and initiates operation by closing the "ON" relay. When the count reaches the "LIMIT" value, the "SLOW" relay is closed. When the count reaches zero, both relays are opened. A new cycle is initialed by again lifting the toggle switch to "PRESET". Note that the PRESET value must be entered each cycle, but the LIMIT value does not have to be re-entered except when power has been removed.

The controller shown is driven by contact closures, so that an SC2 Signal Conditioner option is required. If the input were a tachometer or other high-speed device without contact bounce, an SC1 option is used.

Referring to Figure 1, when the Preset Module toggle switch is lifted up, the PRESET value is loaded into the counter. The No. 1 one-shot multivibrator on the Signal Conditioner is also triggered. Its output sets the No. 1 latch whose output connects to the No. 1 relay driver. When the Counter counts down to the Register value, the EQUAL output sets latch No. 2 on the Signal Conditioner. The latch output connects to the No. 2 relay driver. When the count is equal to zero, the ZERO output of the Counter resets the two latches on the Signal Conditioner and de-energizes the relays. It also triggers the No.2 one-shot multivibrator which generates a 60msec Load pulse.

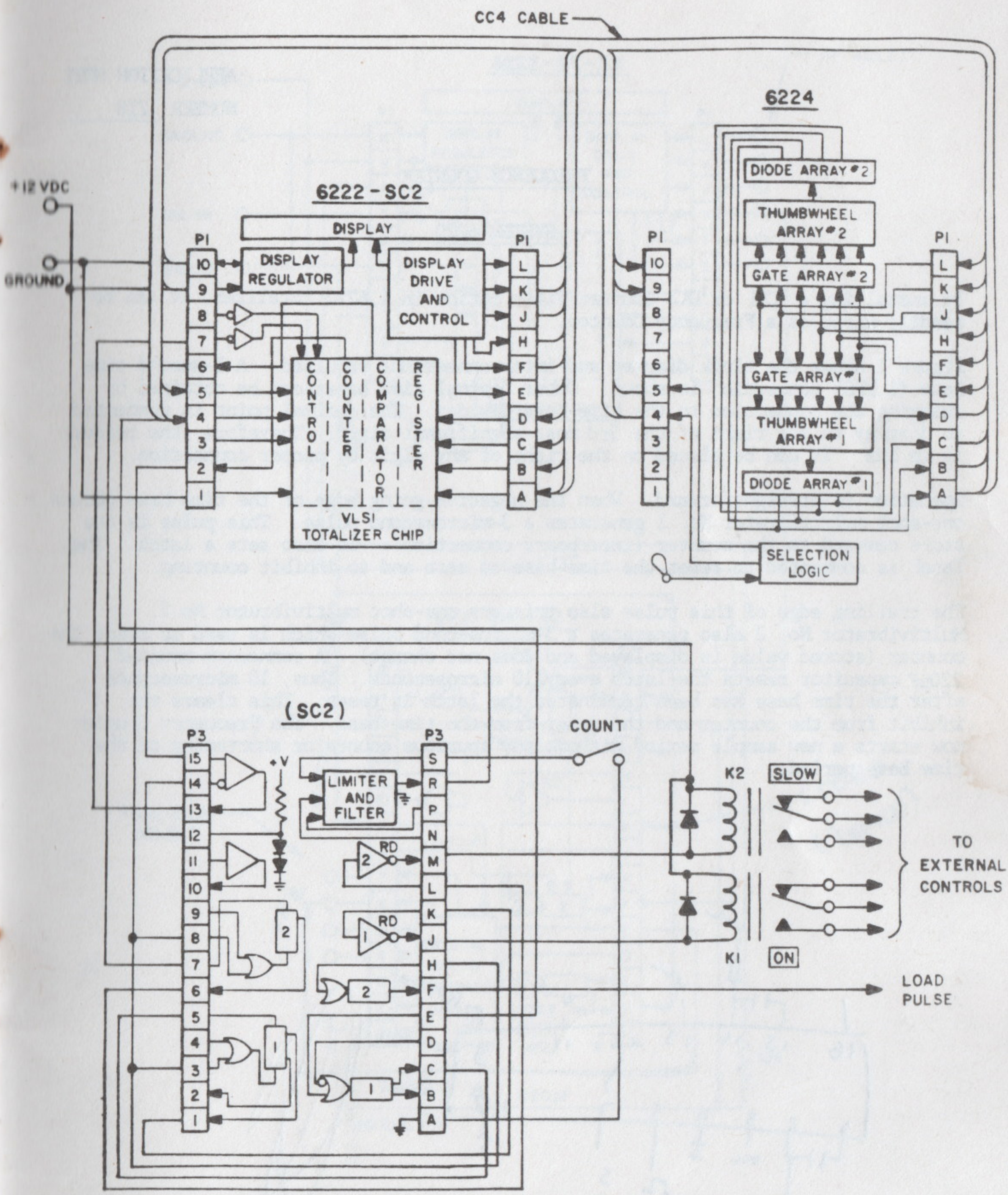


FIGURE 1

UP/DOWN CONTROLLER
(0 to 999999)

APPLICATION NOTE
NUMBER 218

FREQUENCY COUNTER

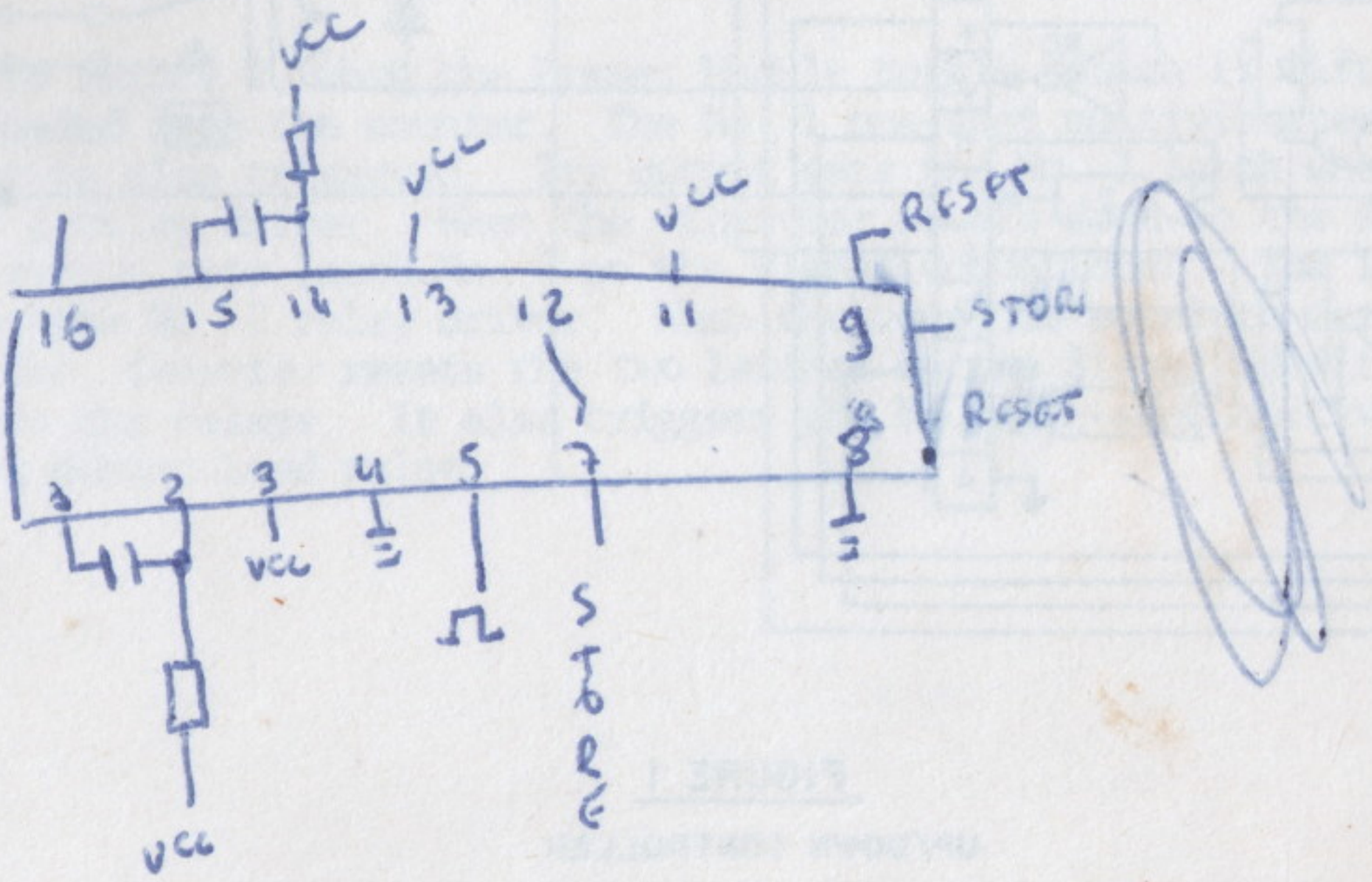
SYSTEM 6220

By installing a TX1 or TX2 Counter/Timer option in a 6222 Totalizer, it can be readily wired as a Frequency Counter.

Figure 1 shows the block diagram and interconnections required. A 1-second time base (1 PPS) connection is shown. Other decimal time bases can be obtained by changing the connection to the time-base divider. The decimal point is connected to display to the right of the 3rd most-significant digit. Therefore, the readout is in KHz. It can be placed on the right of any digit by proper connection.

Operation is straightforward. When the negative-going edge of the time base occurs, one-shot multivibrator No. 1 generates a 3-microsecond pulse. This pulse is the store command to the counter (interboard connection). It also sets a latch. The latch is connected to reset the time-base to zero and to inhibit counting.

The trailing edge of this pulse also triggers one-shot multivibrator No.2. Multivibrator No. 2 also generates a 3-microsecond pulse which is used to reset the counter (stored value is displayed and does not change). A connector-mounted 220pF capacitor resets the latch every 10 microseconds. Thus, 10 microseconds after the time base has been terminated the latch is reset. This clears the inhibit from the counter and the reset from the time base. The Frequency Counter now starts a new sample period without any spurious counts or shortening of the time base period.



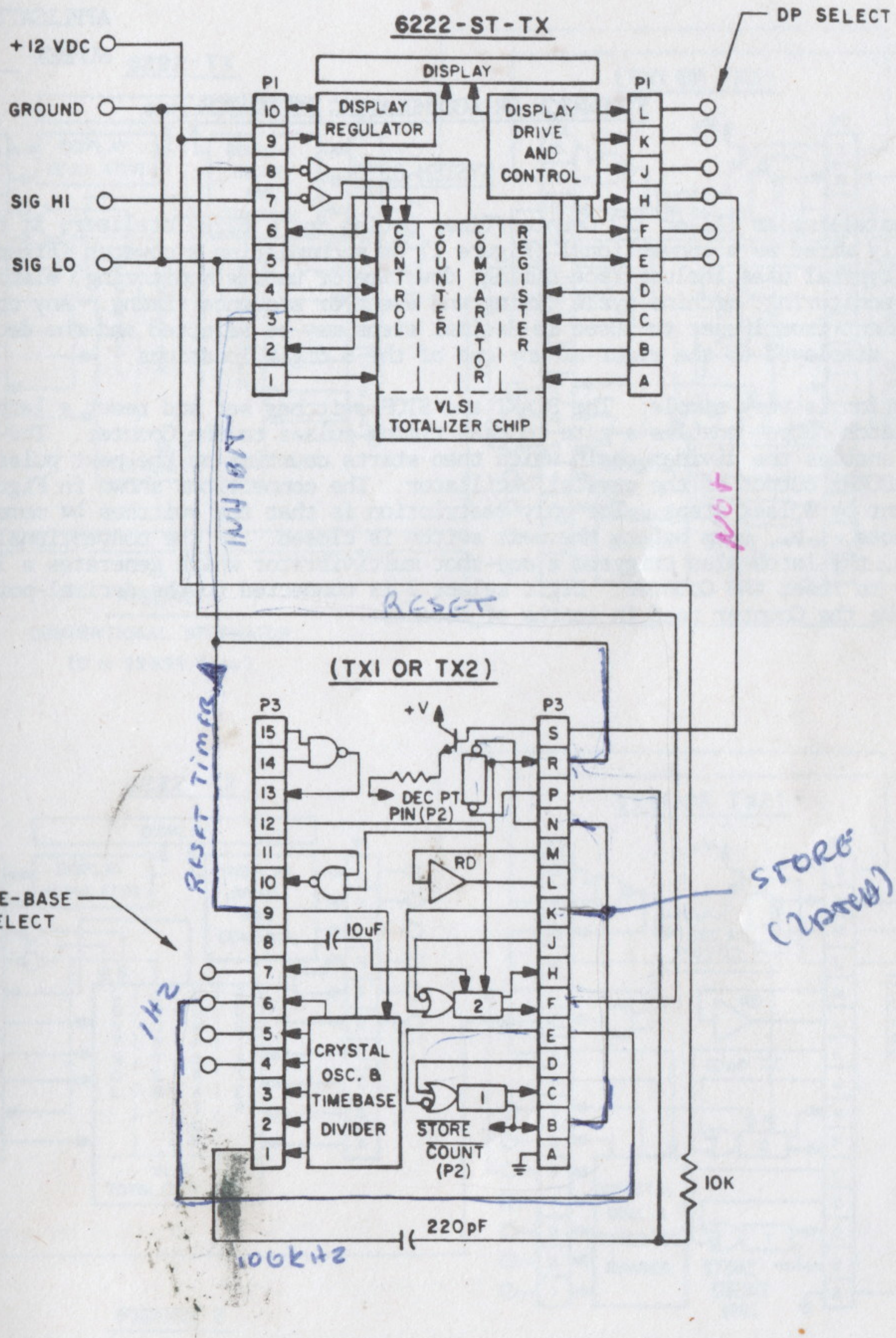


FIGURE 1

FREQUENCY COUNTER
(0 to 999.999 KHz)

APPLICATION NOTE
NUMBER 219

STOPWATCH OR ACCUMULATING STOPWATCH

SYSTEM 6220

By installing an TX1 or TX2 Counter/Timer option in a 6222 Totalizer, it can be readily wired as a conventional (Figure 1) or accumulating stopwatch (Figure 2). Some typical uses include race-timing, downtime or uptime monitoring, elapsed time monitoring, machine cycle timing and event or sequence timing. Any counting increment from 10μsec to 10sec in decimal steps may be selected and the decimal point displayed to the right of any one of the 6 digit locations.

Operation is very simple. The START and STOP switches set and reset a latch. The latch output enables a gate to pass timing pulses to the Counter. The latch also enables the divider chain which then starts counting on the next pulse from the 100KHz output of the crystal oscillator. The connections shown in Figures 1 and 2 count by 0.1sec steps. The only restriction is that the switches be momentary contacts, i.e., open before the next switch is closed. In the conventional stopwatch, the latch also triggers a one-shot multivibrator which generates a 3μsec pulse to reset the Counter. Digit select 2 is connected to the decimal-point driver to make the Counter read in tenths of seconds.

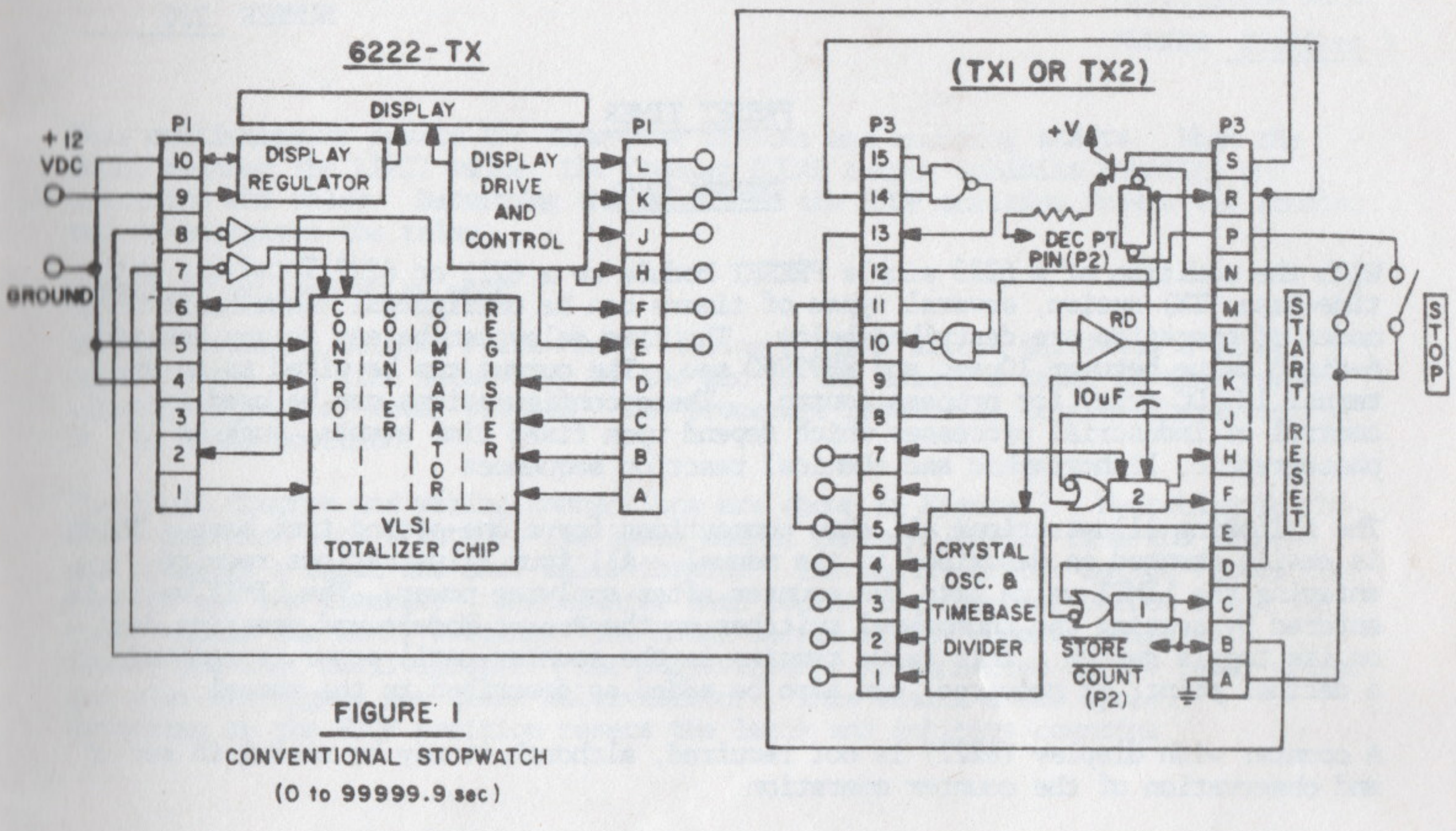


FIGURE 1

CONVENTIONAL STOPWATCH

(0 to 99999.9 sec)

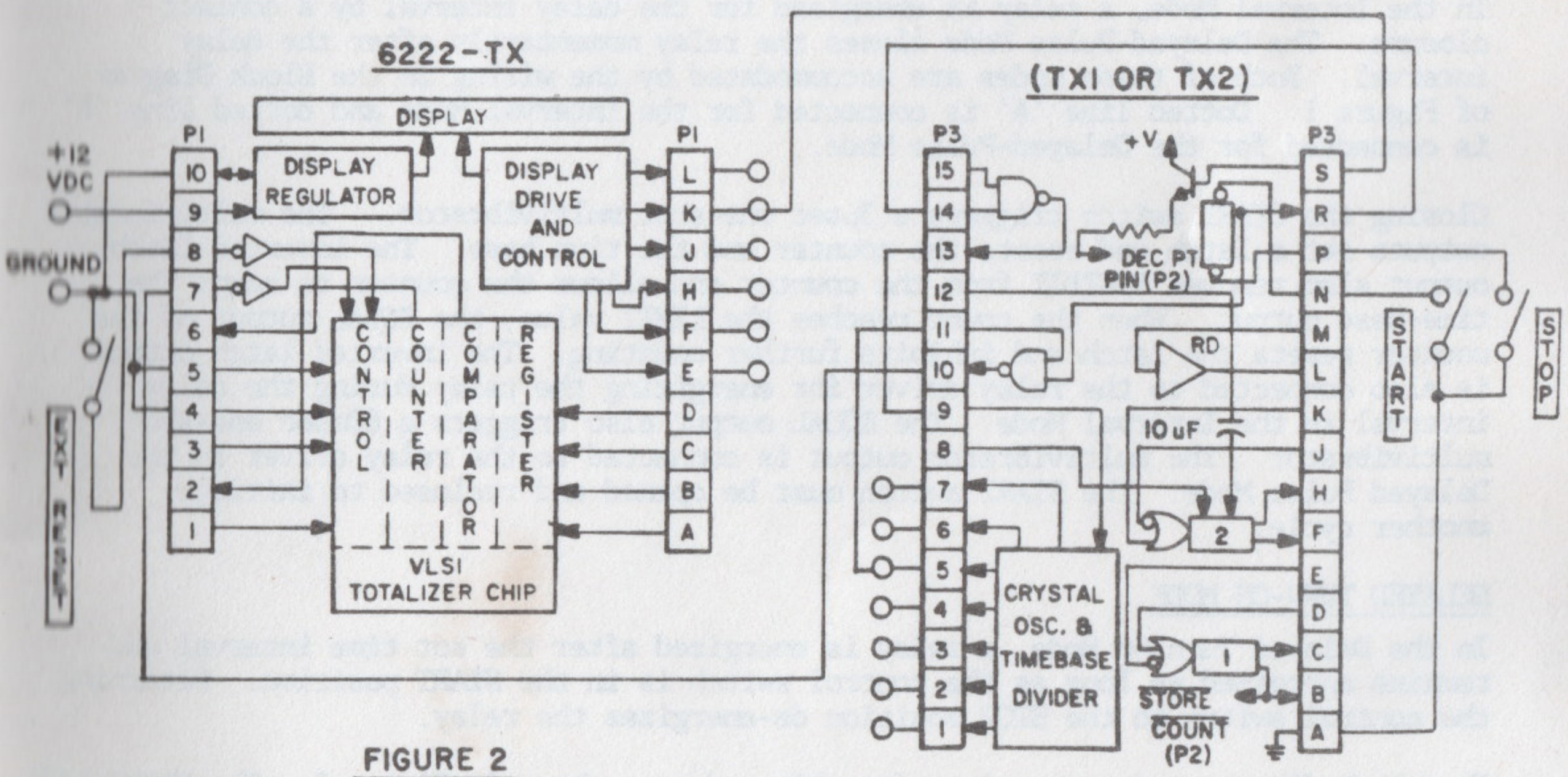


FIGURE 2

ACCUMULATING STOPWATCH

(0 to 99999.9 sec)

APPLICATION NOTE
NUMBER 220

PRESET TIMER

SYSTEM 6220

With the addition of a 6223 single PRESET Module to a 6221 or 6222 Totalizer with time-base (TX) option, several types of timers can be configured. Four basic modes of operation are described below. The time delay can be set to any desired 6-digit value between 10μsec and 9999990 sec. The output can be wired to an external 12V DC relay for process control. These configurations can be used in control of industrial processes which depend upon fixed time events, such as photographic, lithographic and chemical reaction sequences.

The following illustrations all show connections for a one-second time base. This is easily changed as described in the manual. All four illustrations require entering the LIMIT value into the counter after applying power. The LIMIT value is entered by setting the thumbwheel switches on the Preset Module and pressing down on its toggle switch. This value remains in the counter until power is removed. A decimal point, if required, can also be added as described in the manual.

A counter with display (6222) is not required, although it may be useful in set-up and observation of the counter operation.

INTERVAL OR DELAYED PULSE MODE

In the Interval Mode, a relay is energized for the delay interval by a contact closure. The Delayed-Pulse Mode closes the relay momentarily after the delay interval. Both of these modes are accommodated by the wiring in the Block Diagram of Figure 1. Dotted line 'A' is connected for the Interval Mode and dotted line 'B' is connected for the Delayed-Pulse Mode.

Closing the START switch triggers a 3μsec one-shot multivibrator. The multivibrator outputs set a latch and resets the counter and the time base. The inverted latch output also removes INHIBIT from the counter and allows the counter to count the time-base output. When the count reaches the LIMIT value, the EQUAL output of the counter resets the latch and inhibits further counting. The inverted latch output is also connected to the relay driver for energizing the relay during the delay interval in the Interval Mode. The EQUAL output also triggers a 60msec one-shot multivibrator. The multivibrator output is connected to the relay driver in the Delayed Pulse Mode. The START switch must be opened and reclosed to initiate another cycle.

DELAYED TURN-ON MODE

In the Delayed Turn-On Mode, a relay is energized after the set time interval and remains energized as long as the control switch is in the START position. Returning the control switch to the STOP position de-energizes the relay.

The block diagram and connections for this mode are shown in Figure 2. The START/STOP switch is used to set and reset a latch. In the STOP position, the latch is reset. The low output of the latch holds the counter in RESET. Switching to the START position removes the RESET and triggers a 3μsec one-shot multivibrator.

This multivibrator resets the time-base divider and counting starts. When the count reaches the LIMIT value, the counter EQUAL output inhibits counting and energizes the relay. Returning the switch to the STOP position resets the counter and de-energizes the relay.

REPEATING DELAYED PULSE MODE

In the Repeating Delayed-Pulse Mode, closing a START switch initiates a delay equal to the set time interval. At the end of the delay, a relay is momentarily closed and another delay started. The procedure repeats as long as the switch is in the START position.

The block diagram and wiring connections are shown in Figure 3. Switching to the START position sets a latch. The latch output removes INHIBIT from the Counter and triggers a 3µsec one-shot multivibrator. The multivibrator output resets the counter and the timebase. The counter then counts the timebase output until the count equals the LIMIT setting. The EQUAL output of the counter triggers a 60msec one-shot multivibrator. The multivibrator is connected to the relay driver and also retriggers the 3µsec multivibrator. This starts a new cycle. Switching to the STOP position resets the latch and inhibits counting.

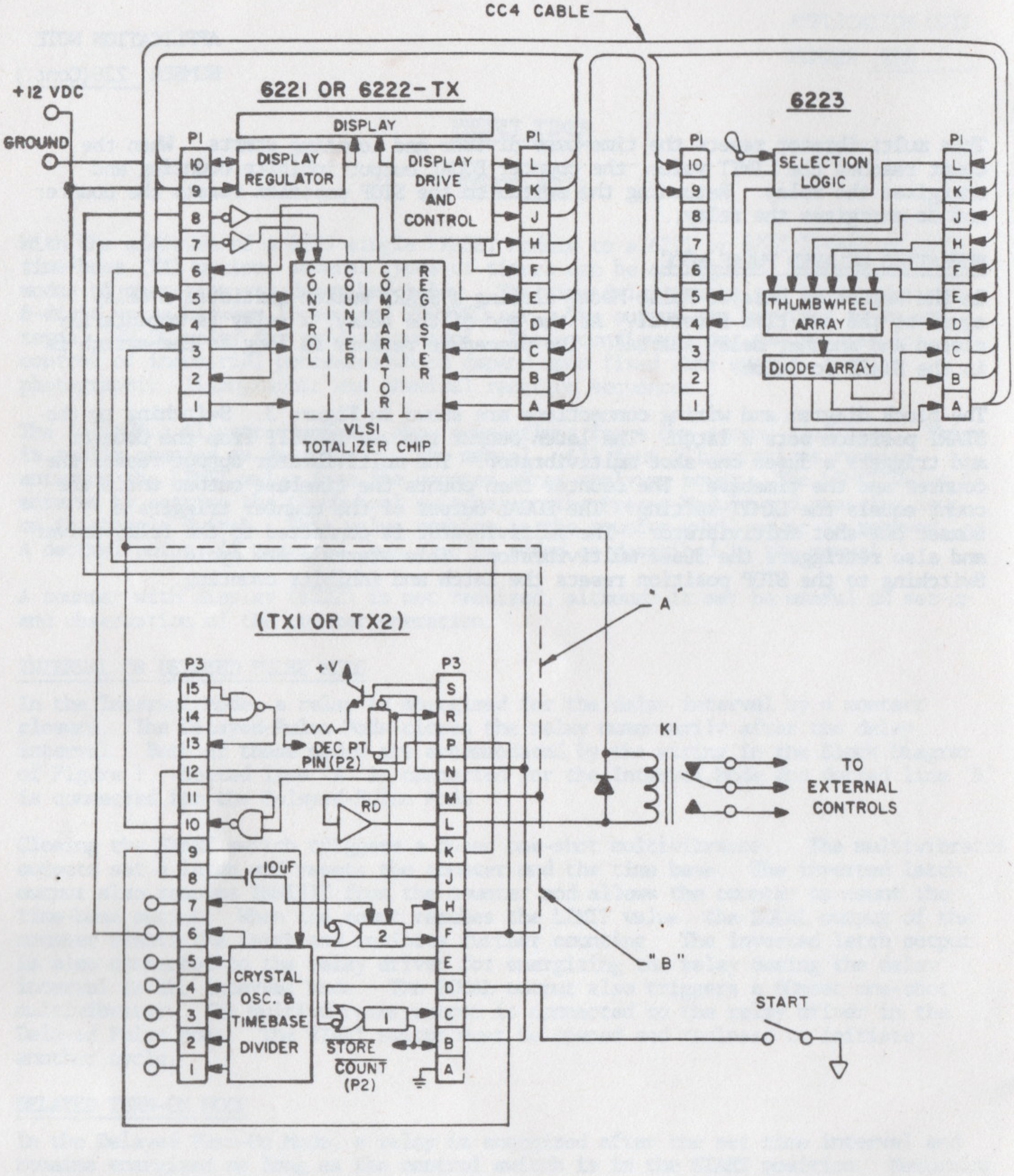


FIGURE 1

PRESET TIMER
(A) INTERVAL MODE
(B) DELAYED-PULSE MODE
(0 to 999999 sec)

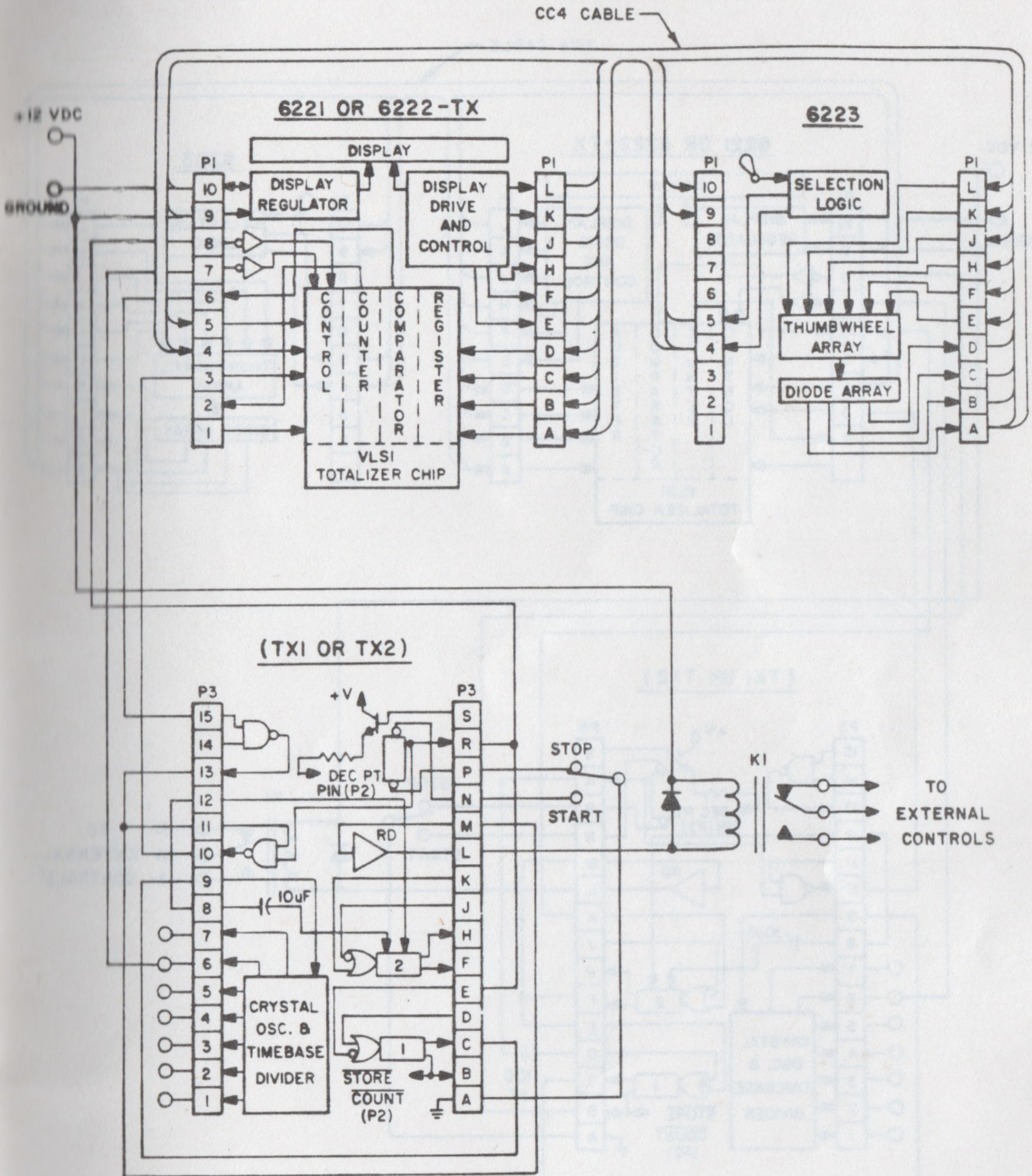


FIGURE 2

PRESET TIMER
DELAYED TURN-ON MODE
(0 to 999999 sec)

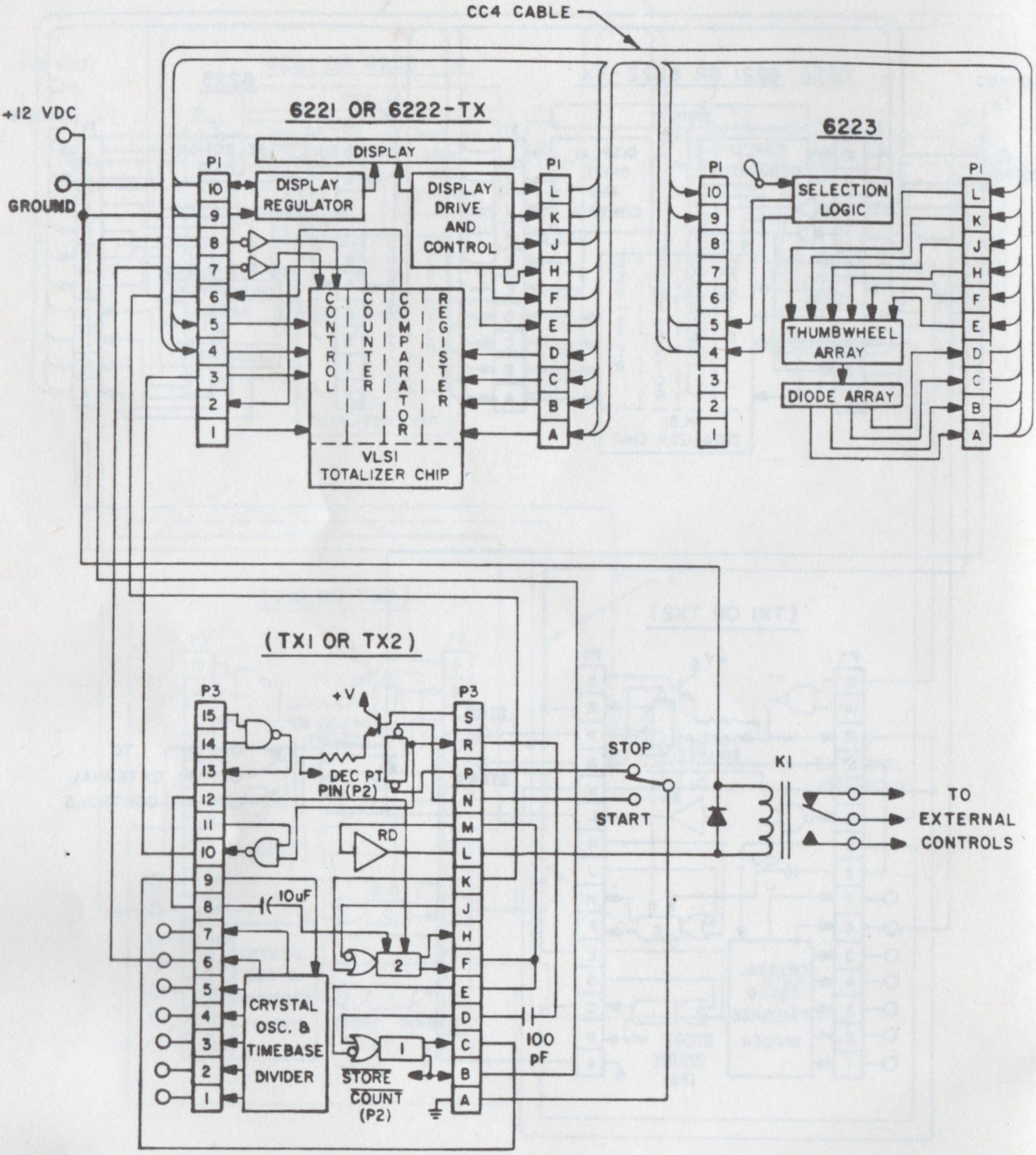


FIGURE 3

PRESET TIMER
REPEATING DELAYED-PULSE MODE
(0 to 999999 sec)

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APPLICATION NOTE
NUMBER 221

PRESCALING COUNTER

SYSTEM 6220

Adding a 6221 Totalizer without display and a 6223 Preset Module to a Frequency Counter (Application Note 218) makes it into a Prescaling Counter. A Prescaling Counter is one in which the incoming signal frequency gets divided by a whole number N (entered as the 6223 LIMIT value) and multiplied by the timebase in seconds.

Typcial applications are the visual display of an incoming frequency which can be scaled down by dividing by a whole number, such as gallons-per-minute from a flowmeter input, a miles-per-hour display from a tachometer, or a tons-per-hour display from a conveyor-belt pickup. The Prescaling Counter works best for higher frequency input rates. A Factoring Counter (Application Note #222), which uses different wiring of the same modules, works best for lower frequency input rates.

Figure 1 shows the block diagram and interconnections for the Prescaling Counter. First, the divisor N is set as the LIMIT value on the 6223 thumbwheel switches. It is entered by pressing down in its toggle switch. This value remains in the 6221 counter until changed or until power is removed. The toggle switch is then lifted to preset the 6221 counter within its count range. The EQUAL output of the 6221 triggers the No. 2 3µsec one-shot multivibrator on the TX option. The output of this multivibrator resets the 6221 counter to zero and is counted by the 6222 counter. The 6221 then counts up to N and repeats the process. The 6222 counter with TX option is a frequency counter. When the negative going edge of the time base occurs, the No. 1 one-shot multivibrator generates a 3µsec pulse. This pulse is the store command to the counter (interboard connection). It also sets a latch. The latch is connected to reset the time base to zero and to inhibit counting. The latch and pulse outputs are gated together to reset the counter after the count is stored. A connector-mounted 220pF capacitor resets the latch every 10µsec This clears the inhibit from the counter and reset from the time base. A new sample period is started without any spurious counts or truncated time base period. The one-second time-base connection is shown. Other decimal time bases are obtained by changing the time-base divider connection. The decimal point is connected to the right of the 5th most-significant digit. It can be placed on the right of any digit by proper connection.

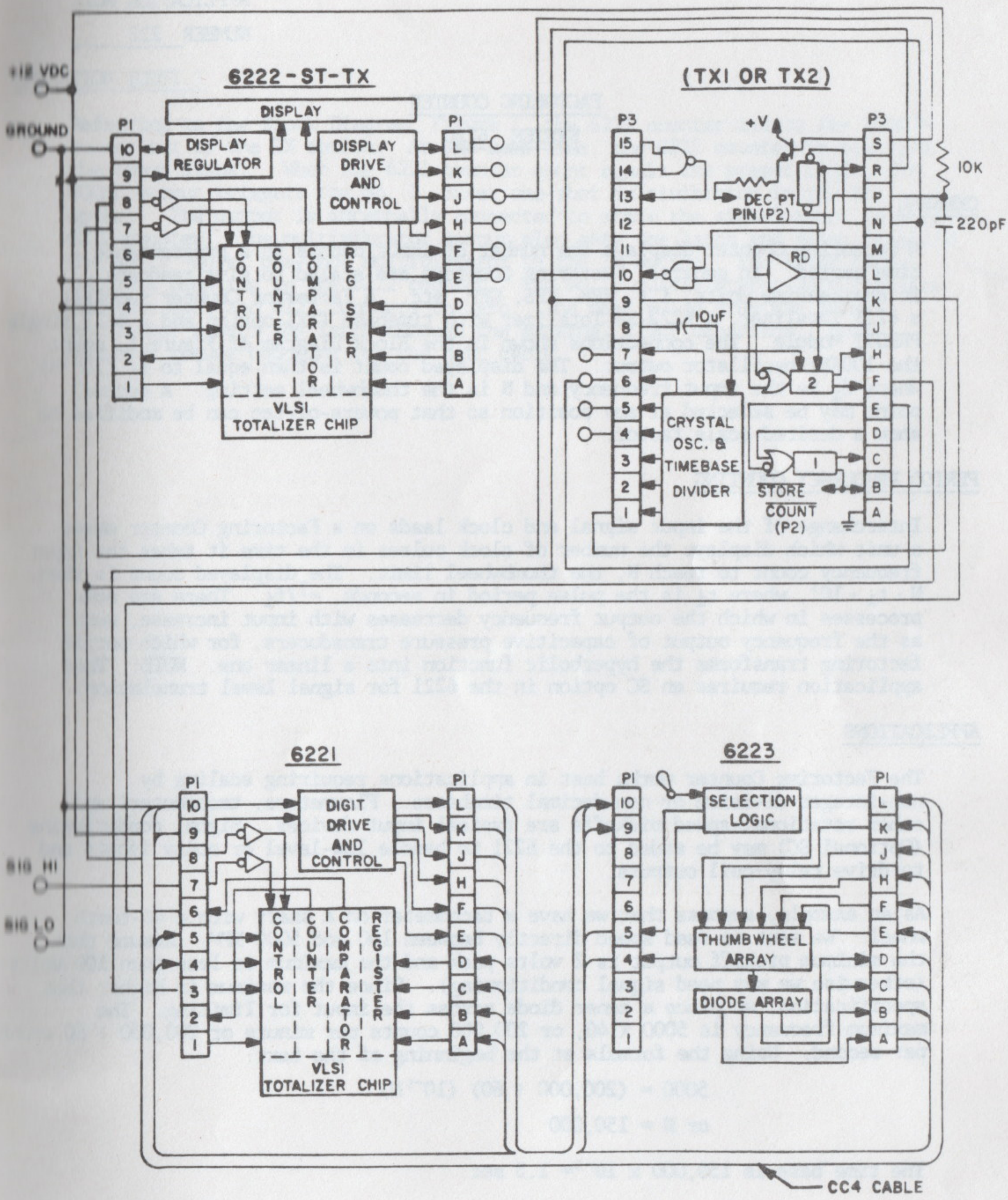

FIGURE 1

PRESCALING COUNTER
(0 to 9999.99)

APPLICATION NOTE
NUMBER 222

FACTORING COUNTER
SYSTEM 6220

GENERAL

A Factoring Counter displays the number of input counts in a programmable time period. In general, Factoring Counters are scaled to give readouts in engineering units, i.e. RPM, FPS, GPM, etc. A Factoring Counter requires a 6221 Totalizer, a 6222-ST Totalizer with timebase (TX) option and a 6223 single PRESET Module. The connections shown in the Block Diagram of Figure 1, count the 100KHz oscillator output. The displayed count is then equal to f_i $(10^{-5}N)$, where f_i is the input frequency and N is the thumbwheel setting. A decimal point may be selected at any position so that powers-of-ten can be modified to show a desired scale factor.

PERIOD FREQUENCY COUNTING

Interchange of the input signal and clock leads on a Factoring Counter makes a unit which displays the number of clock pulses in the time it takes the input frequency count to reach N, the thumbwheel limit. The displayed count is then $N \cdot t_i \cdot 10^5$, where t_i is the pulse period in seconds, $=1/f_i$. There are some processes in which the output frequency decreases with input increase, such as the frequency output of capacitive pressure transducers, for which period factoring transforms the hyperbolic function into a linear one. NOTE: This application requires an SC option in the 6221 for signal level translation.

APPLICATIONS

The Factoring Counter works best in applications requiring scaling by non-integer division or non-decimal timebases. Flowmeters, tachometers and other rotational-speed pickoffs are typical input devices. Signal conditioning (Optional SC) may be added to the 6221 to handle low-level or noisy inputs and to drive relay-coil outputs.

As an example, suppose that we have a tachometer on a shaft with a 40-tooth wheel. We want to read speed directly between 100 and 5000 RPM. Assume that the minimum pickoff output is 2 volts peak and the maximum is less than 100 volts (otherwise we may need signal conditioning). Since the maximum is higher than specification, we place a zener diode across the input for limiting. The maximum frequency is 5000 X 40, or 200,000 counts per minute or 200,000 ÷ 60 counts per second. Using the formula at the beginning of the text:

$$5000 = (200{,}000 \div 60)\ (10^{-5}N)$$

$$\text{or } N = 150{,}000$$

The time base is $150{,}000 \times 10^{-5} = 1.5$ sec.

OPERATION

After applying power, the LIMIT value is entered into the 6221 by setting the thumbwheel switches on the Preset Module to N and pressing down on its switch. This value remains in the counter until power is removed. Then push up on the toggle switch to preset the counter to its limit value (this insures that the 6221 is within its count range).

OPERATION (CONT.)

Referring to the Block Diagram, Figure 1, the 6221 counter counts the 100KHz pulses out of the TX option. At the same time, the 6222 counter is counting the input signal. When the 6221 counter count equals the preset LIMIT, the EQUAL output triggers the No. 1 3µsec one-shot multivibrator in the TX option. Its output is internally connected to store the signal count in the 6222 counter. The multivibrator output also sets the latch and delay triggers the No. 2 3µsec one-shot multivibrator in the TX option. The latch output inhibits counting in the 6222 counter. The No. 2 multivibrator output resets both the 6221 and 6222 counters to zero. The next pulse from the 100KHz oscillator resets the latch through the external 220pF capacitor. Both counters resume counting for the next cycle.

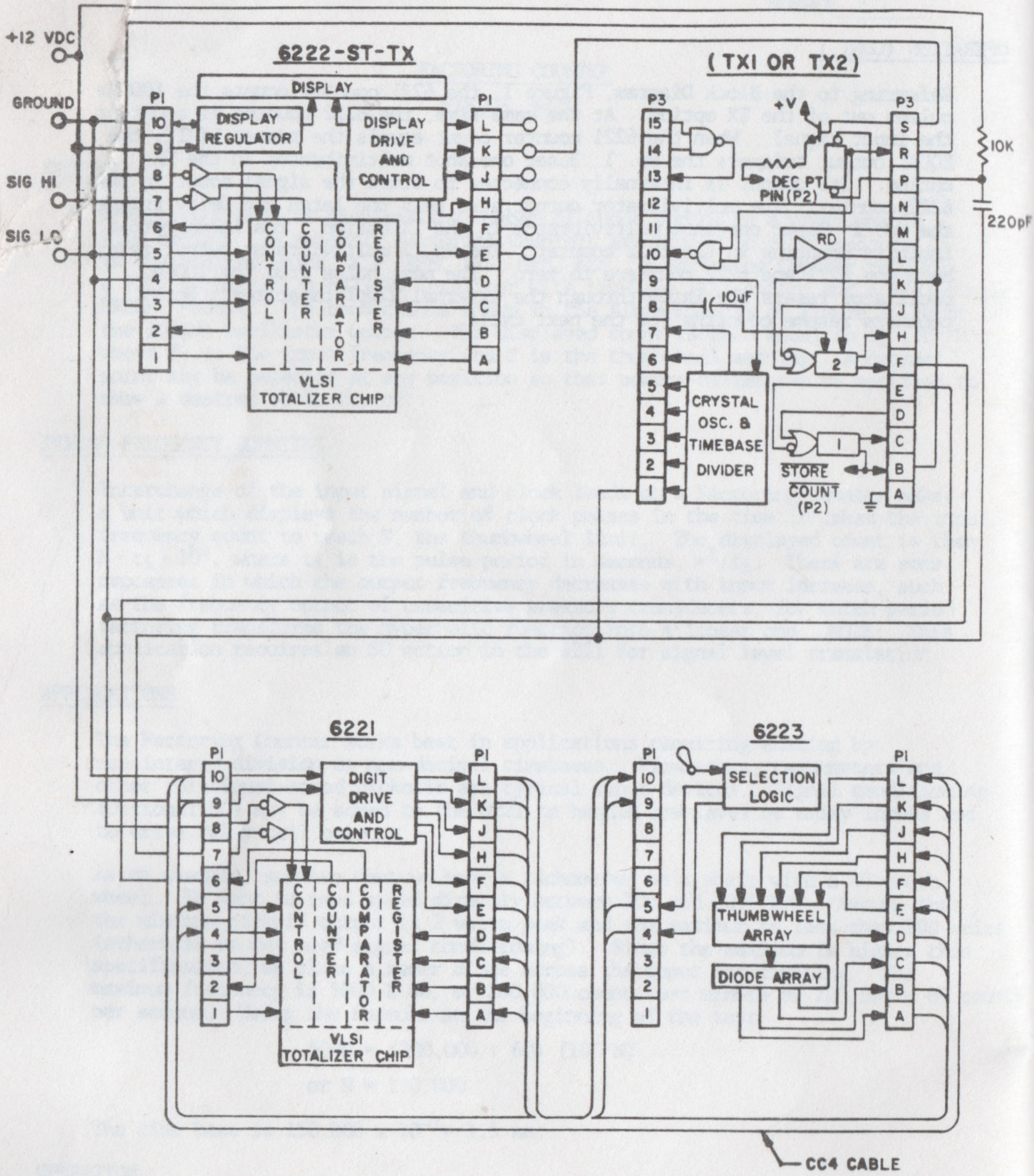

FIGURE 1

FACTORING COUNTER

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APPLICATION NOTE
NUMBER 223

DIGITAL RATIOMETER

SYSTEM 6220

If a frequency meter is designed with a timebase generated by counting a second frequency to a fixed count, a scaled ratio is displayed. The displayed value = N = N_2 (F_1/F_2) where N_2 is the LIMIT value. If N_2 is a power of 10; i.e., 100, 1000, 10000; the displayed value is the ratio or percentage (with proper decimal point placement). The Digital Ratiometer is very versatile because scaling can be performed on related frequency sources by changing N_2. The Digital Ratiometer is implemented, as shown in the Block Diagram of Figure 1, with a 6222 Counter with SC3 option, a 6221 Counter and a 6223 Single Preset Module.

Applications include the display of the ratio of two rates in concurrent units such as miles per gallon, rolling-mill billet elongation, fluid flow to turbine speed, and slip measurement. Electronic applications include carrier modulation, FM and telemetry monitoring.

Referring to Figure 1, after applying power, the LIMIT value, N_2, is entered into the 6221 by setting the thumbwheel switches on the Preset Module and pressing down on its toggle switch. This value remains in the counter until power is removed or another value entered. Then push up on the toggle switch to preset the counter to the LIMIT value (this insures that the 6221 is within the count range). The EQUAL output of the 6221 triggers the No. 1 3µsec one-shot multivibrator on the SC3 option. The multivibrator output stores the F_1 count in the 6222 (internal connection), sets the #1 latch and triggers the #2 3µsec one-shot multivibrator on its trailing edge. This multivibrator resets both counters to zero using relay driver No. 1 as an inverter. The latch inhibits the 6222 Counter. The next F_2 pulse sets the latch and both counters resume counting. Both input signals, F_1 and F_2, have high speed (200 KHz) signal conditioning for logic level inputs. When the F_2 count in the 6221 reaches the LIMIT value, an EQUAL output is generated and the cycle repeats.

Without precise-value initial resetting, the first reading of a series will be in error.

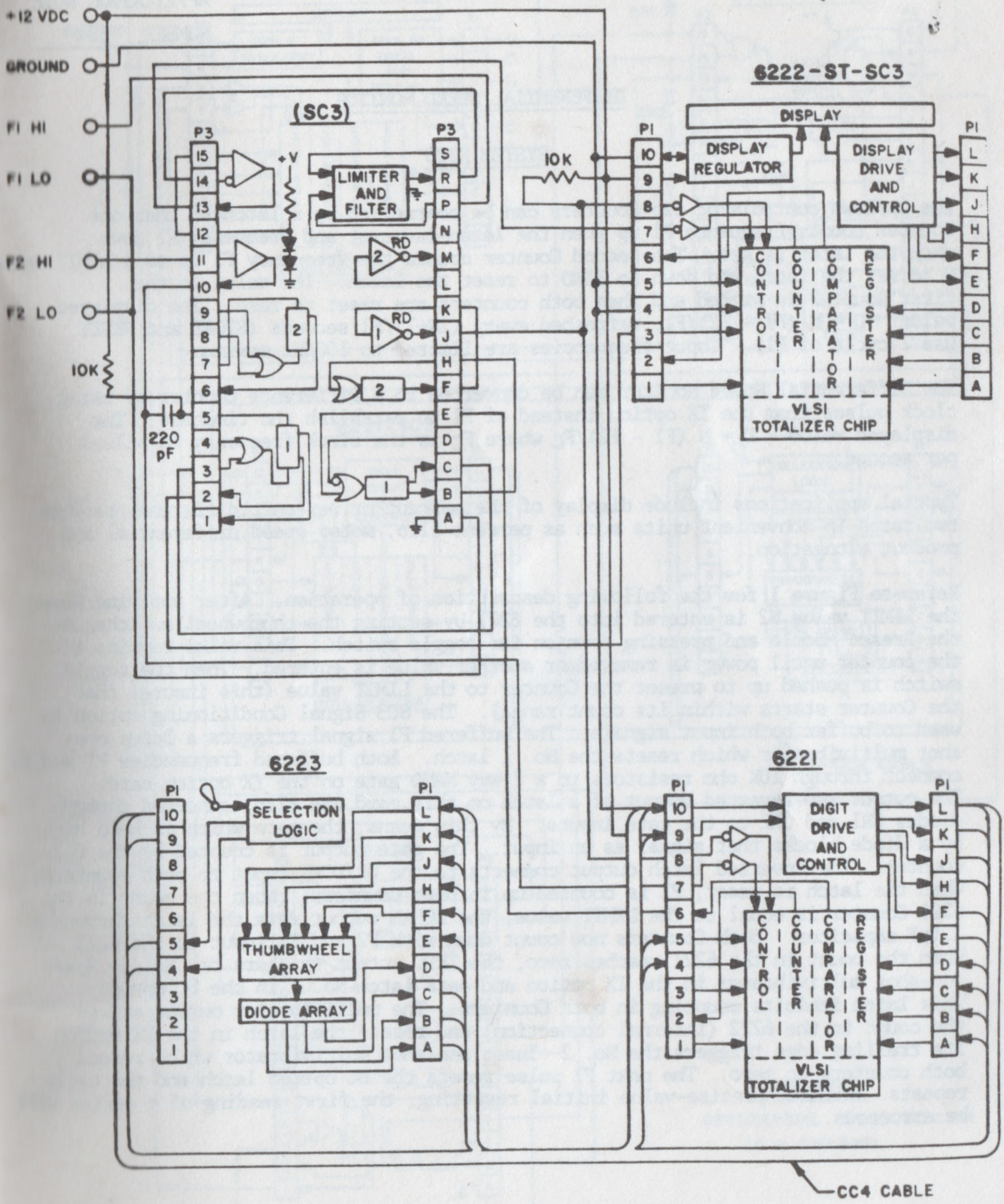


FIGURE 1

DIGITAL RATIOMETER

APPLICATION NOTE
NUMBER 224

DIFFERENTIAL SPEED MONITOR

SYSTEM 6220

The Up/Down controls of two Counters can be controlled by a latch so that one Counter counts frequency F1 up when the latch is reset and frequency F2 down when the latch is set. The second Counter counts the frequency F1 up to a LIMIT value N to set the latch and down to ZERO to reset the latch. The value in the first Counter is stored and then both counters are reset to zero. The displayed value: $D = N (F1 - F2)/F1$, refreshed every $(2N+1)/F1$ seconds (STORE and RESET use 1 cycle of F1). Input frequencies are limited to 100KHz maximum.

The Differential Speed Monitor can be converted to a Difference Counter by using clock pulses from the TX option instead of F1 to establish the timebase. The displayed value = $D = N (F1 - F2)/F_C$ where F_C is the clock frequency in pulses per second.

Typcial applications include display of the percent or per-unit difference between two rates in convenient units such as percent slip, motor speed differential and product elongation.

Refer to Figure 1 for the following description of operation. After applying power, the LIMIT value N2 is entered into the 6221 by setting the thumbwheel switches on the Preset Module and pressing down on its toggle switch. This value remains in the counter until power is removed or another value is entered. Then the toggle switch is pushed up to preset the Counter to the LIMIT value (this insures that the Counter starts within its count range). The SC3 Signal Conditioning option is used to buffer both input signals. The buffered F1 signal triggers a 3µsec one-shot multivibrator which resets the No. 1 latch. Both buffered frequencies F1 and F2 connect through 10K ohm resistors to a 2-way NAND gate on the TX option card. The output and inverted output of a latch on this card are also connected through diodes CR1 and CR2 to the gate inputs. By this means, the gate which is held high by a diode blocks that signal as an input. The gate output is counted by the 6222 Counter. The inverted latch output connects to the UP/DOWN input to both counters. When the latch is reset, F1 is counted up in both Counters. When the count in the 6221 Counter is equal to the LIMIT value, the EQUAL output sets the latch through a 220pF capacitor. Both Counters now count down with F2 and F1 input to the 6221. When the count in the 6221 reaches zero, the ZERO output triggers the No. 1 3µsec one-shot multivibrator in the TX option and sets latch No. 1 in the SC option. This latch inhibits counting in both Counters. The multivibrator output stores the count in the 6222 (internal connection) and resets the latch in the TX option. Its trailing edge triggers the No. 2 3µsec one-shot multivibrator which resets both counters to zero. The next F1 pulse resets the SC option latch and the cycle repeats. Without precise-value initial resetting, the first reading of a series will be erroneous.

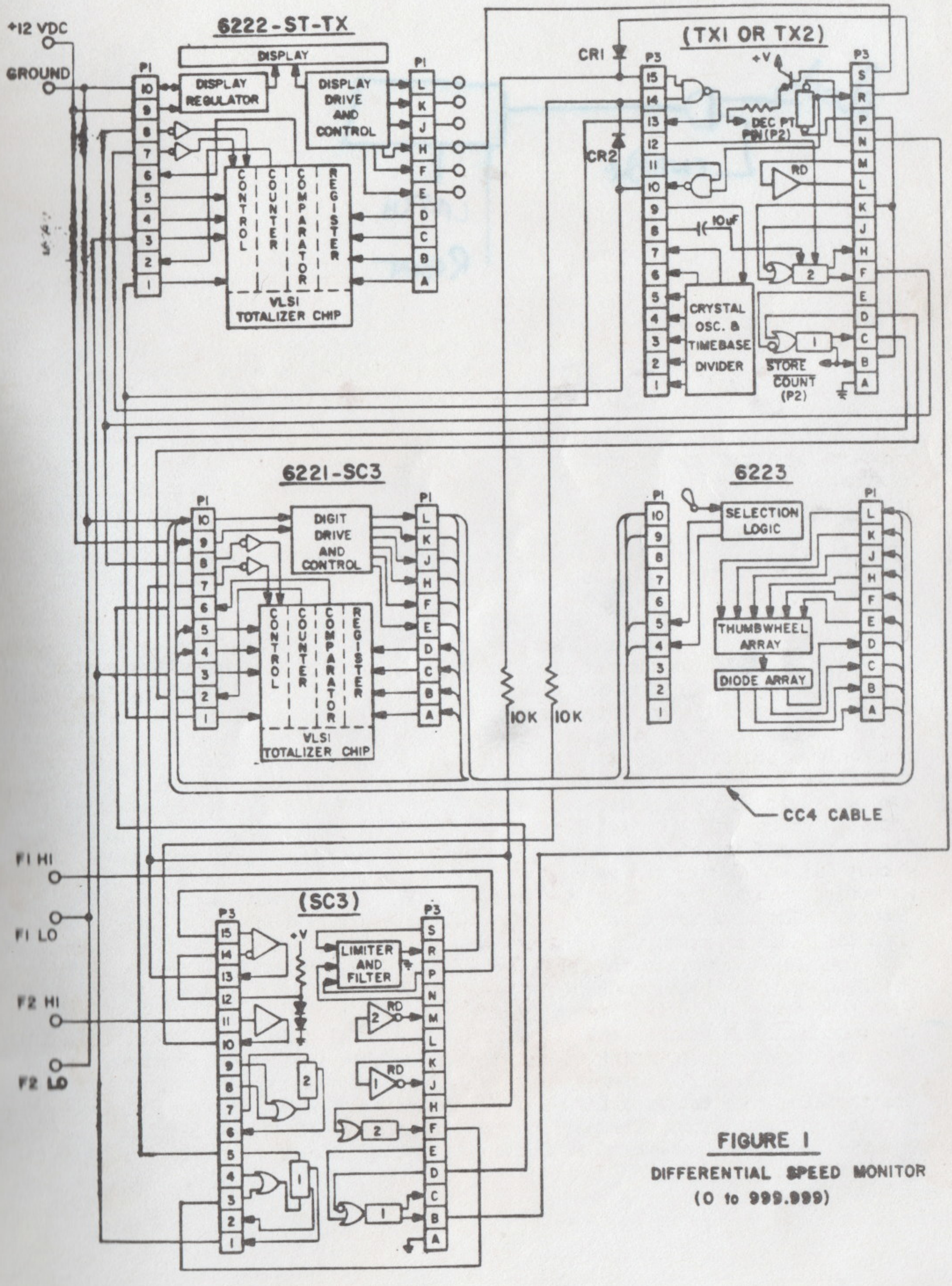
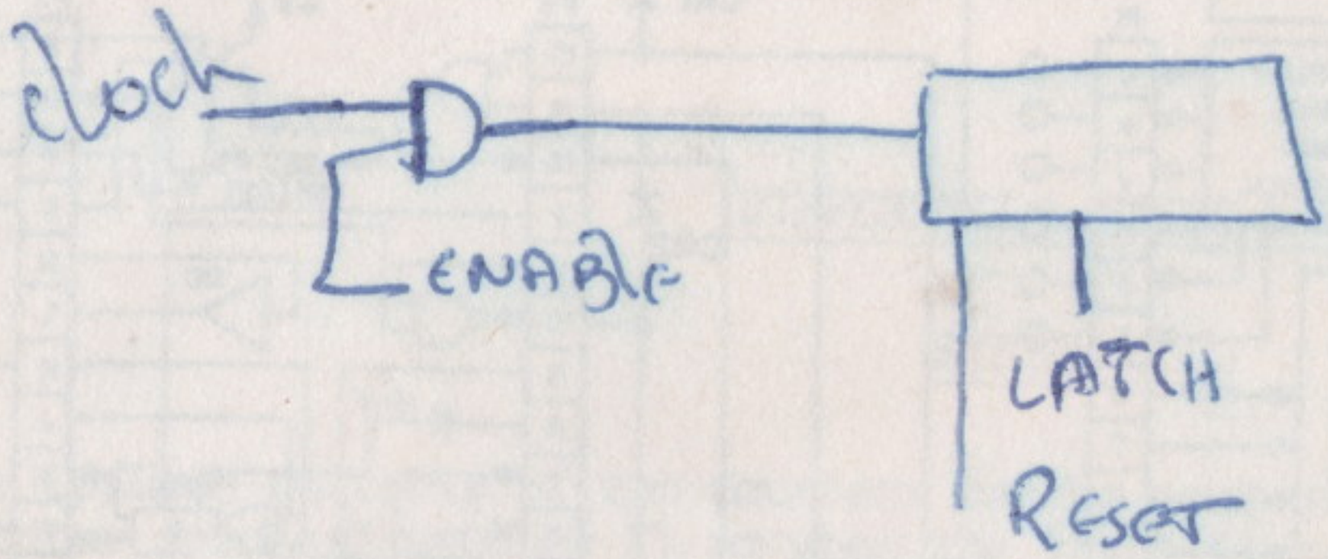


FIGURE 1

DIFFERENTIAL SPEED MONITOR
(0 to 999.999)



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